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INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI

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No.	Date	Pages
2740	July 4	1– 22
2741	“ 11	23– 46
2742	“ 18	47– 72
2743	“ 25	73– 92
2744	August 1	93–112
2745	“ 8	113–134
2746	“ 15	135–154
2747	“ 22	155–174
2748	“ 29	175–194
2749	September 5	195–228
2750	“ [illegible]	229–252
2751	“ [illegible]	253–278
2752	“ 26	279–304
2753	October 3	305–330
2754	“ 10	331–354
2755	“ 17	355–378
2756	“ 24	379–404
2757	“ 31	405–430
2758	November 7	431–454
2759	“ 14	455–478
2760	“ 21	479–502
2761	“ 28	503–528
2762	December 5	529–554
2763	“ 12	555–602
2764	“ 19	603–624
2765	“ 26	625–646

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portance of Ecology in the Training of Engineers

Paul B. Sears
Oberlin College, Oberlin, Ohio

I SHALL BEGIN WITH THE STATEMENT OF several propositions:

(1) Engineers and those who direct their activi- now play a great, if not a preponderant, part in ng the daily activities and thus the general pattern of American life.

(2) The fundamental and inescapable basis of human ture lies in its relation to the means of subsistence—the maintenance of soil, the conservation of water through agriculture and the related arts which apply biology.

(3) Engineering activities profoundly affect the material and energy cycle upon which civilization rests.

(4) Engineering students, along with those preparing for the practice of medicine, rank among the groups having the highest intelligence in American colleges and universities.

(5) Current and accepted practice in the training of gineers affords practically no opportunity to learn the ndamentals of biological science.

The means of subsistence and much of the essential energy and raw materials needed by the people of the United States depend upon the order and balance of the landscape. The fixation of carbon by green plants, which is the fundamental process in living nature, depends upon the maintenance and improvement of soil and the conservation of moisture for its efficiency. Technological activities which interfere with these processes run counter the general welfare in that respect, introducing factors ich are just as essential to good engineering practice as a knowledge of dynamics, design, or materials.

The problem can be exemplified as follows:

Highway construction. This operation involves drainage, ally designed with but one end in view: to keep water from the crown of the highway and move it away as rapidly as possible. The aggregate area of highway appears to be about 1 per cent of the national area. If this meant a reduction of only 1 per cent in the moisture ailable for agriculture, it would not be serious. But our hway system drains much of the adjacent land and stitutes a rectilinear system of general drainage, sup- nting the natural curvilinear system of stream tribu- ries.

This superposed drainage pattern has two serious consequences. It accelerates movement of water into main channels in flood time and interferes with maintenance of ground-water level by removing water before it can soak in. Also, by speeding the movement of water in earth channels, it leads to roadside erosion and consequent lateral gullies into agricultural land. These problems are most serious on locally built and maintained roads—the so-called county laterals. In one group of counties studied, the average county road level had been lowered three feet in 40 years and was responsible, in large part, for an average of 10 gullies to the mile in adjacent farm land. The total mileage of such local roads is many times that of main highways.

Stream sanitation. Neglecting the amenities to which streams and ponds contribute, the potential food production from clean inland waters is about equal to that of good average farm land, acre for acre, and increases up to a limit with increase in depth. Millions of dollars are spent annually in the stocking of inland waters in the United States, but this money is largely wasted and an important food resource rendered useless by industrial waste and urban sewerage. While this tremendous and tangible loss can be attributed to social and economic faults, it actually stems from defective ideals of industrial and municipal engineering design. Such designs are not technically complete unless they reckon with the disposal of waste in a manner that will not produce economic loss and damage to other property, public or private. In the Miami River, in August 1946, over 200,000 fish were killed by the toxic wastes of one industrial plant, for example.

Stream control. This has as its primary objective the lessening or prevention of flood damage, but the conservation of water for public use and navigation is scarcely less important. Apart from increased use due to greater population density, the per capita requirements for water are steadily increasing with technological advances and improved living standards. The hydrology of a stream extends to the limits of its drainage basin, and fundamental hydraulics needs to reckon with the impact of raindrops as well as the phenomena of large volumes of water. The point of view with which the ecologist approaches water relations is as essential to stream control as the conventional approach of the engineer and must be incorporated into engineering techniques to make them effective. The fact that an ecological approach has been used in such projects as the Tennessee Valley Authority and the Muskingum Watershed Conservancy District is likely to cause overoptimism. One dam, built since 1935 at a cost of over $20,000,000, was completed without attention to ecological factors. In fact, the suggestion

Presentation before the Symposium on Applied Ecology of the Ecological Society of America, AAAS Boston Meeting, December 28, 1946.

that the valley be regarded as a unit and attention be given to soil and drainage conditions upstream was vigorously rejected. Within a few years after completion, the dam had intensified flood damage, and the reservoir behind it was silting rapidly, leading to a frantic demand for improved land use upstream. Sound engineering design would have reckoned with these hazards in the first place, in addition to those recognized by custom as engineering problems.

Turning now to the curricula in engineering schools, those of 10 leading institutions, with enrollments from 2,100 to 4,900, are of interest. In none of them does the generalized first-year course call for, or even allow, any biological instruction, nor is any provided for in any of the subsequent specialized years, with the exceptions to be noted. The normal courses in civil engineering usually include water supply and sewerage engineering, but for these the prerequisite is hydraulics only. In one school engineers may take forestry and conservation among their 15 hours of electives. The two other schools offering such courses appear to limit them to agricultural engineers, and even if they did not, the usual practice with electives for engineers is to confine them to strictly professional subjects. In three instances courses in soil mechanics are provided, but it appears from the descriptions that none of these goes beyond the promise of its title in giving an understanding of soil fundamentals. Thus, it is either difficult or impossible at present for civil engineering students to have contact with a field vitally related to their work. This is even more true of engineers, chemical, mechanical, and electrical, who will be expected to design industrial plants.

Two special fields of engineering involve biology explicitly. The first is agricultural engineering, the second in its fullest flowering is known as biological engineering. Agricultural engineers vary in training from civil engineers with courses in agronomy and animal husbandry (no basic biology and no ecology) to agricultural majors with sufficient engineering electives to qualify them. The latter may or may not have had ecological training—generally not. From observation I would say that much of the success of graduate agricultural engineers depends upon their boyhood experience with soil, water, growing crops, and domestic animals. They are at least aware of certain phases of reality which to the city-bred graduate engineer are a closed book.

Biological engineering, as exemplified in one of the 10 institutions, is slanted toward industrial production of biological materials and includes adequate training for certain types of biological research, fundamental in character but wholly remote from environmental studies—that is, ecology. From this high point it grades down to sanitary and water supply engineering which, as we have noted, is innocent of fundamental biological discipline.

In only one of the institutions under discussion is a course in ecology available, and then outside the pale of engineering education. In three of the schools, courses in conservation are offered to, and, it is to be hoped, elected by, engineers.

These matters concern the self-interest of the engineering profession no less than the interest of the public. In 1936–37 the head of an engineering school was greatly concerned because he could not place his graduates in civil engineering. Yet there was at that time an acute shortage of technicians to serve the numerous soil conservation districts then being organized. If these graduates had had the slightest knowledge of soil and vegetation, they would have been in demand. At his request a special course was organized in one of the biological departments of his university. One engineer attended the first meeting of this class—a graduate assistant who was sent over to learn the ropes, in full confidence that he could pass on any necessary information to young engineering students by sandwiching it in between really important matters. When the situation was brought before the director, he explained that required courses in engineering left no time for anything else, and that his school would lose its rating if he interfered with custom! In view of this, his original proposal was puzzling, to say the least.

Recently one of the engineering officials of a major American corporation, speaking before the alumni council of an excellent technical school, said bluntly that from his experience he would rather have engineers trained in the liberal arts atmosphere of a small college, which he named, than the crack professionals from this technical school. He went on to say that the men with a liberal arts background were more resourceful, more flexible, and more imaginative in their approach, all of which more than compensated for their lack of specialized technical courses. It was his opinion that, with a proper foundation, these specialties could be picked up on the job. What had been lost through lack of broad training could not. In my observation, one of the things least likely to be acquired without some measure of formal training is a comprehension of broad biological principles.

The biological profession is not without responsibility for the situation which has been described. In its general courses it has ridden evolution to death, emphasizing technicalities of structure and function while neglecting the great framework of life and environment which gives these technicalities their significance. Many such courses are geared frankly to the supposed needs of future professional biologists. They would ill serve the needs of engineers who took them. And, assuming that ecology is offered (which is not yet the case in many institutions of higher learning), these formalized courses in beginning biology constitute a *cheval-de-frise* that must be encountered first.

Biological science has much to offer that is of extreme importance to the engineer and to the future layman as well. I suspect that such material is of no less importance as an introduction to the professional study of biology. It is perfectly possible to teach a respectable introductory course so that no future engineer who takes it will thereafter be blind to the broad biological consequences of his professional work. But until such a reform in emphasis and arrangement comes from our side of the fence we are in a poor position to urge that the fence be let down.

At a higher level of instruction, it will be a great contribution if we can overhaul our courses in ecology, building them squarely into the structure of the other natural sciences. The possibility of this was suggested long ago by Henderson in his *Fitness of the environment*. It has been carried beyond the point of suggestion by both Jenny and Nikiforoff in their studies of soil energetics and has been considered by Transeau in relation to vegetation. Unquestionably, much more research is needed on such problems as the energy patterns of plant communities and drainage systems. But the basic means exist for organizing what we know so that it will carry its influence down to the elementary level in biology. Once this is done, that influence may extend across boundaries of knowledge to command the professional respect and serve the needs of that magnificently disciplined group of our colleagues, the engineers.

Meanwhile there is the possibility that those who train engineers may take some initiative in the matter. It is encouraging to note that The Ohio State University, along with several other institutions, is inaugurating an optional five-year engineering course in the hope that it will result in broader training. I do not envy the dean who attempts seriously to liberalize the present tight curricula. It will take courage to follow the course of reform in medical schools; it will take even more to avoid the pitfalls which have at times defeated the intent of premedical liberal education. I predict, however, that the first good engineering school to grapple boldly with the problem will acquire such prestige that other institutions will hasten to follow its example. It is generally true that the schools with the highest standards have the longest and best waiting list.

Shift of Employment Among Younger Scientists

M. H. Trytten, *Director*
Office of Scientific Personnel, National Research Council, Washington, D. C.

SCIENTIFIC PERSONNEL HAS PROBABLY never experienced the situation now existing with respect to demand. The unprecedented enrollment in institutions of higher education and the great expansion in scientific work generally have resulted in extraordinary recruitment efforts by employers. Evidence of unusual shifting of employment by scientists has been apparent. In particular, the less fortunately situated higher educational institutions have complained of the difficulty of recruiting and maintaining faculties in the sciences. The implications of rapid shifting are clear enough to require no elaboration. The smaller institutions do train a very large proportion of the higher-education population. Should much shifting occur, it would seem likely that properly qualified instructors would become unavailable for a significantly large part of the students in colleges and universities.

To secure some measure of this trend, the Office of Scientific Personnel of the National Research Council has polled a sample of those receiving doctoral degrees in the sciences in the years 1936–45, inclusive. The survey was confined to 13 disciplines in which the maximum competition for personnel among educational institutions was expected. About 10 per cent of the total number was selected as a sample, with slightly higher numbers in some disciplines. The survey was confined to the years stated, since the future of the sciences lies largely in the hands of the younger men. This does not mean that older scientists are not shifting. But especial importance seems to attach to the distribution of those who must be the leaders of science in the near future. Although replies are arriving daily, the present study includes only approximately the first two-thirds to reply. A rough check of perhaps 200 later replies does not alter the results significantly.

One interesting fact is that almost 10 per cent of the questionnaires were returned without forwarding addresses. Since the original addresses were in practically all cases relatively recent, the implication is that most of these individuals had shifted employment. Thus, figures on shifts in employment given below must be corrected upwards by a figure of 9 per cent or less, depending on the interpretation of the lack of proper address.

Table 1 shows the shifting occurring within the past 12 months among the first 975 scientists replying to the questionnaire. It will be seen that 248, or 25.4 per cent, have actually changed employment. The greatest shifting is within education. Here, 92, or about 10 per cent, of the younger scientists have changed jobs. Most of these have found more favorable employment in some other educational institution, although 26 have left the field of education. The Government has lost about 80 scientists, most of these going, presumably, to the universities and colleges. Much of this probably occurred early in the year, when wartime researches were terminating.

TABLE 1

Present-Day Shifting of Scientists Awarded Ph.D. Degrees During the Decade 1936–45, Inclusive

Changed within the last year:	Agriculture	Bacteriology & microbiology	Biochemistry	Botany	Chemistry	Engineering	Entomology	Geology	Mathematics	Physics	Physiology	Psychology	Zoology	Totals	Per cent
From Federal Gov't to Education	3	2	2	4	8	3	2	4	5	5	6	7	1	52	5.3
" " " " Industry	2	2	2	1	2	1	1	0	3	1	1	0	1	17	1.7
" " " " State Gov't	0	0	1	0	0	0	1	0	0	1	0	1	1	5	.5
" " " " Federal Gov't	0	1	2	1	0	0	0	0	0	2	0	4	1	11	1.1
" " " " School or Military	0	1	0	0	0	0	1	0	0	0	0	0	2	4	.4
From State Gov't to Education	0	0	0	1	0	0	1	0	0	0	0	0	0	2	.2
" " " " Industry	0	0	0	0	0	0	0	0	0	0	0	1	0	1	.1
" " " " State Gov't	0	0	0	0	0	0	0	0	0	0	0	1	0	1	.1
" " " " Federal Gov't	1	0	0	0	0	0	0	0	0	0	0	0	1	2	.2
" " " " School	0	0	0	0	0	0	0	0	1	0	0	0	0	1	.1
From Industry to Education	0	0	2	1	2	2	0	3	3	5	1	3	0	22	2.2
" " " Industry	1	2	2	1	7	4	1	4	0	4	1	2	0	29	2.9
" " " State Gov't	0	0	0	0	0	0	0	0	0	0	0	0	0	0	—
" " " Federal Gov't	0	1	2	0	1	0	0	0	1	3	0	0	0	8	.8
" " " School or Military	0	0	0	0	0	0	0	0	0	1	0	0	0	1	.1
From Education to Education	3	2	8	6	4	2	5	2	9	6	5	6	8	66	6.8
" " " Industry	0	2	2	0	2	3	1	0	0	0	2	1	1	14	1.4
" " " State Gov't	0	0	0	0	0	0	1	0	0	0	0	0	0	1	.1
" " " Federal Gov't	1	2	1	0	1	1	0	0	1	0	0	3	0	10	1.0
" " " School	0	0	1	0	0	0	0	0	0	0	0	0	0	1	.1
Totals	11	15	25	15	27	16	14	13	23	28	16	29	16	248	25.4

Total number of questionnaires sent: 1,600; total number of replies received: 975; questionnaires returned—forwarding addresses unknown: 91; unemployed: 17; per cent known to have changed within last year: 25.4.

The survey also elicited information on firm commitments to shift employment. Although Table 1 shows that 248 younger scientists have changed employment, there are, in addition, 135 younger scientists who have positive commitments to change, either by accepting new positions or by signing contracts. There are significant differences in the nature of these expected shifts. The shifts from the Federal Government are proportionately much less, accounting for only 20 per cent of the shifts, whereas the shifts from the Federal Government in Table 1 account for 36 per cent. In education, however, the shifting is heavy. Almost 60 per cent of the expected shifts occur either from educational institution to educational institution or out of education to industry and the Government. Shifts from one educational institution to another account for 66 out of 92 of these shifts.

Thus, 383 shifts in employment among 975 younger scientists have occurred recently or will take place shortly. (A scientist shifting twice in this period is counted but once.) This is over 39 per cent. Adding to this a conservative 5 per cent from those whose addresses are unknown, it is safe to say that nearly 45 per cent of the scientists in this age group have changed or will change employment in an 18-month period beginning about a year ago, if our sample is a valid indication. There seems little reason to doubt its fairness.

The question was asked as to whether the respondent was now contemplating or seeking a change. About 20 per cent of those not covered above replied in the affirmative, and the proposed nature of the change was indicated in a few cases. If these changes eventuate, the total changes will approach the two-thirds mark. However, the likelihood of changes in all these cases is not determinable.

The total picture, however, is certainly indicative of an abnormal condition which has serious implications. This information has been furnished to the President's Scientific Research Board, which will discuss the phenomenon together with other information in the report on scientific personnel.

Table 2 is a tabulation of the returns to give an indication of the employment of these younger scientists. It should be noted in particular that industry and the Federal Government employ almost half of this group. The decreasing incidence of scientists in the military services is interesting.

Table 3 shows the activity of the younger scientists. Particularly noteworthy is the fact that while Table 2 shows that education employs more than the Federal Government and industry together, Table 3 indicates that many more scientists list research, rather than teaching, as their activity. The totals in this column are not exclusive, but there seems reason to believe that a significant number listed as employed by educational institutions are actually spending full time on subsidized research. It seems probable that some of the recent shifting is toward contract research.

TABLE 2

Distribution of Employment of Scientists Earning Ph.D. Degrees During the Decade 1936–45, Inclusive

Employment	Full and part-time employment*					
	Federal Gov't	State Gov't	Industry	Education	Military†	Unemployed‡
May 1, 1946	137	52	305	472	36	13
%	13.5	5.1	30.0	46.5	3.6	1.3
May 1, 1947	114	52	309	520	3	17
%	11.2	5.1	30.4	51.2	.3	1.6
Near future§	105	43	326	526	4	17
%	10.3	4.2	32.0	51.5	.4	1.7
Future‖	104	43	323	532	4	17
%	10.2	4.1	31.6	52.0	.4	1.7

* About 40 individuals are working in more than one category.

† Military men not counted in Federal Government column.

‡ Returned to school: 13; women who have married: 4.

§ Assuming present commitments are fulfilled and "definite offers likely to result in change of employment" are accepted.

‖ Assuming changes are made for which desire is expressed.

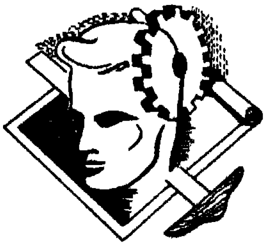
In a report to the President, "A Program for National Security," by the Advisory Commission on Universal Military Training, figures are given for expenditures in 1947 for research as differentiated from development (p. 179). The figure in the Government, in universities, and in industry is about $335,000,000. This is probably about five times the rate of expenditure in 1937, since this is the ratio of expenditure for research and development in 1947 and in 1932. The resulting personnel demand accounts for the present unprecedented situation in employment. It seems obvious that careful thought is needed to insure that the stresses resulting from this situation do not militate against the soundness of scientific development.

TABLE 3

Types of Work Being Done by Ph.D. Scientists

	Agriculture	Bacteriology & microbiology	Biochemistry	Botany	Chemistry	Engineering	Entomology	Geology	Mathematics	Physics	Physiology	Psychology	Zoology	Totals	Per cent
Part or full-time teaching	27	17	26	35	36	39	26	21	53	45	32	42	60	459	38.0
Part or full-time research	46	40	52	25	109	48	38	26	18	81	29	31	31	574	45.7
Part or full-time administration	14	14	12	4	30	30	9	20	8	13	9	14	7	184	14.6
Unemployed*	1	1	2	0	2	0	3	1	2	1	1	1	2	17	1.4
Military	0	1	0	0	0	0	0	0	0	1	1	0	0	3	0.3

* Returned to school: 13; women who have married: 4.



Financial Reports of the AAAS for 1945

F. R. Moulton, *Administrative Secretary*

THE FINANCIAL STATEMENTS OF THE Association which follow are condensations of the audited reports by G. P. Graham & Company, certified public accountants, for the calendar year 1945. During the war period it was not possible to obtain prompt audits of the Association's accounts. Audited reports for the calendar year 1946 are expected within a few months.

For many years the records of the finances of the Association have been kept in two almost completely independent accounts, that of the Treasurer and that of the Administrative Offices. The former includes all the permanent funds, such as those the income from which may be used only in support of research, those given for providing emeritus memberships, and those awarded as prizes for meritorious scientific work. The latter includes all receipts, expenditures, and balances incident to the operations of the Association, such as dues from members, expense of the offices, holding meetings, etc.

TREASURER'S ACCOUNTS

The following statement of receipts and disbursements describes the financial transactions of the office of the Treasurer during the calendar year 1945; the balance sheet, the condition of the Treasurer's accounts at the close of the year, December 31, 1945.

Statement of Receipts and Disbursements

Receipts

Interest and dividends received	$ 3,514.09
Contributions in support of research	400.00
Life membership fees	4,900.00
Grant for research returned	91.05
George Westinghouse Science Writing Award Fund	7,500.00
Sale and redemption of securities	111,290.54
Total initial cash and receipts	$127,695.68

Disbursements

Grants in aid of research	$ 1,486.00
Journal subscriptions (life members, etc.)	1,743.00
Emeritus life membership fees	1,500.00
Miscellaneous items	70.57
Securities purchased	120,051.60
Total disbursements	$124,851.17
Excess of receipts over disbursements	$ 2,844.51

Balance Sheet as of December 31, 1945

Assets

Cash	$ 38,132.40
Due from Administrative Office (building fund, etc.)	49,204.36
Securities in portfolio	249,711.81
Accrued interest and dividends	883.75
Total assets (Treasurer's Account)	$337,932.32

Liabilities

Endowment and restricted funds	$175,491.15
Building fund*	48,602.56
Funds for general purposes	49,747.67
Current (Academy grants, prize funds, etc.)	13,136.94
Reserve funds	38,740.71
Accumulated income	12,213.29
Total liabilities (Treasurer's Account)	$337,932.32

* Building fund was used, in part, for purchase of property at 1515 Massachusetts Avenue, Washington 5. D.C.

ADMINISTRATIVE OFFICES ACCOUNTS

The corresponding statements of receipts and disbursements of the Administrative Offices of the Association for the calendar year 1945 are as follows:

Receipts

Dues from members	$128,200.00
Interest on bank accounts	143.95
Journal subscriptions for life members, etc.	1,743.00
Sale of Summarized Proceedings, etc.	64.43
Total receipts	$130,151.38

Disbursements

Salaries of office employees	$ 34,286.51
Postage, printing, office supplies, etc.	6,334.67
Executive Committee	1,574.69
General Secretary's office	317.96
Printing and mailing *AAAS Bulletin*	3,756.67
Circularization for members	2,517.02
Allowances to Pacific and Southwestern Divisions	3,604.00
Secretaries' conferences	597.88
Section expenses	311.84
Net disbursements for journals	23,970.78
Total expenditures	$ 77,272.02
Excess of receipts over expenditures	$ 52,879.36

NEWS *and Notes*

Frank T. Gucker, Jr., Department of Chemistry, Northwestern University, has been appointed chairman, Department of Chemistry, Indiana University, succeeding **Ralph L. Shriner,** recently appointed head of the Organic Division, Department of Chemistry, State University of Iowa. Dr. Gucker will assume his new duties September 1.

H. J. Stafseth, professor of pathogenic bacteriology, Michigan State College, has been appointed head, Department of Bacteriology and Public Health, and director of Biological Sciences. Prof. Stafseth has recently returned from China, where he served as a technical adviser to the Chinese Ministry of Agriculture.

Arthur H. Graves, curator of Public Instruction, Brooklyn Botanic Garden, retired July 1 after 26 years of service. Dr. Graves will continue researches, begun in 1910, on a deadly fungus disease of the American chestnut tree.

William V. Houston, president of Rice Institute, and **Ralph P. Agnew,** chairman, Department of Mathematics, Cornell University, will be visiting professors at Case Institute of Technology during the summer session. Dr. Houston will lecture and consult on research problems, as well as carry on his own investigation in quantum mechanics. Prof. Agnew will teach a course in Infinite Series and Summability. The visiting professorships are made possible by a grant from the Cleveland Foundation.

D. W. Thorne, associate professor of agronomy, Utah State Agricultural College, has been appointed to succeed **R. J. Evans,** head of the Department of Agronomy since 1930, who retired on July 1.

Frederick Wyatt, chief psychologist, McLean Hospital, Waverley, Massachusetts, has been appointed associate professor (affiliate), Department of Psychology, Clark University. Dr. Wyatt will take part in the training program in clinical psychology and will also continue his work at the McLean Hospital.

William von Fischer, a member of the Department of Chemistry, Case School of Applied Science, since 1935, has been promoted to professor of chemistry.

Robert B. Woodward, associate professor of chemistry, Harvard University, has announced the first synthesis of substances with general molecular structural characteristics identical with those of fibrous proteins. The synthesis, the closest man-made substance to nature-made proteins, introduces an entirely new class of synthetic materials from which useful fibers and transparent films can be made.

M. C. Kik, associate professor of agricultural chemistry, College of Agriculture, University of Arkansas, has been decorated by the Government of the Netherlands in appreciation for services rendered during and after the war. Prof. Kik has been made an officer in the Order of Orange-Nassau.

Ezra T. Cresson, Jr., associate curator, Department of Insects, Academy of Natural Sciences of Philadelphia, resigned July 1 after 39 years of service. The Board of Trustees of the Academy has designated him a Research Fellow of the institution.

F. H. Spedding, director, Institute for Atomic Research at Iowa State College, has been elected associate chairman of the Board of Governors of the Argonne National Laboratory.

C. N. Hugh Long, Sterling professor of physiological chemistry, Yale University, has been appointed dean, School of Medicine, succeeding **Francis G. Blake.**

Herbert A. McCullough, Bessie Tift College, Forsyth, Georgia, has been appointed associate professor of botany, Howard College, Birmingham, Alabama.

Ira H. Cram, geologist, Pure Oil Company, Chicago, and past-president, American Association of Petroleum Geologists, gave the annual petroleum geology lectures at the University of Michigan, May 1 and 2.

Andrew Ellicott Douglass, director emeritus, Steward Observatory, and professor of astronomy and dendrochronology, University of Arizona, was recently honored at a dinner given in observance of his approaching 80th birthday. At that time, a group of his colleagues and associates presented to the University a bronze plaque to mark the extensive State Museum exhibit of Dr. Douglass' researches in climatology and dendrochronology.

John L. Bray, head, School of Chemical and Metallurgical Engineering, Purdue University, since 1935, will retire September 1, and will be succeeded by **R. Norris Shreve,** professor of chemical engineering. Dr. Bray will continue as professor of metallurgical engineering.

M. A. Basoco, Department of Mathematics and Astronomy, University of Nebraska, has been appointed chairman of that Department, succeeding **Ralph Hull,** who will resign August 31 to become mathematician in the Physical Research Unit, Boeing Aircraft Company, Seattle, Washington.

David L. Thomson, dean, Faculty of Graduate Studies and Research, McGill University, has been appointed Gilman Cheney professor of biochemistry, succeeding **J. B. Collip,** who has resigned to become dean, Faculty of Medicine, University of Western Ontario.

Otto Storch, after much suffering under the Nazi regime in Austria, has recently been appointed director of the Zoological Institute, University of Vienna, according to word received from Paul Weiss, University of Chicago. Prof. Storch would greatly appreciate receiving from American zoologists reprints of their articles published since 1940.

Grants and Awards

Grants-in-aid to enable 47 outstanding scientists to attend the 6th International Congress for Experimental Cytology, meeting in Stockholm, July 10–17, were announced by UNESCO June 20. Recipients from the United States include: F. Nord, professor of chemistry, Fordham University, New York City; S. Speigelman, Washington University School of Medicine, St. Louis, Missouri; and Paul Weiss, professor of zoology, University of Chicago.

A. Remington Kellogg, curator, Division of Mammals, U. S. National

Museum, was the recipient of the University of Kansas Alumni Association Award for Distinguished Service, June 16.

Rufus A. Lyman, founder and editor, *The American Journal of Pharmaceutical Education*, and retired dean, Pharmacy College, University of Nebraska, was recently awarded the Remington Medal for outstanding work in pharmacy, presented by the American Pharmaceutical Association.

Harry A. Waisman, formerly research associate, Department of Biochemistry, University of Wisconsin, received the Borden Award for Research in Medicine at the University of Wisconsin. The award is given annually to the senior medical student who has completed the most research while in medical school.

Summer Programs

The University of Nebraska Laboratory of Anthropology will be field headquarters for the Missouri River Basin Archaeological Program for 1947, which was started early in June. The program is under the direction of the Smithsonian Institution, in cooperation with the Bureau of Reclamation, the Corps of Engineers, the National Park Service, and local institutions in the 10-state basin area. The work this summer, which will consist of continued surveys and some test excavations at about 33 sites of multipurpose dams and reservoirs having a "high priority" in the Missouri River Basin flood control and reclamation program, will be directed by Waldo R. Wedel, Wesley L. Bliss, Joseph Bauxar, Paul Cooper, John Hughes, and Marvin Kivett, archaeologists, and Theodore White, paleontologist.

Union College, Schenectady, New York, has awarded 50 six-week, all-expense General Electric Science Fellowships for summer study to high school science teachers in eight northeastern states. The 17 women and 33 men will be taught the theory behind scientific discoveries made during the war years in physics and chemistry and will witness these discoveries in actual use through visits to modern industrial laboratories.

The fellowship program, now in its third year, also emphasizes development of new techniques for teaching scientific concepts. Fellows will study under the college faculties of physics and chemistry. Nine members of the General Electric Company laboratory and engineering staffs will assist in presentation of the course and demonstrations.

Meetings

The Annual Symposium of the Society for the Study of Development and Growth will be held at the University of Connecticut, Storrs, August 26–29. The program will include papers by Alexandre Rothen, Rockefeller Institute for Medical Research, on "Long-Range Forces Between Macromolecules"; Robley C. Williams, University of Michigan, "Electron Microscopy in Biology"; Jacques Monod, Pasteur Institute, Paris, "Enzymatic Adaptation and Its Bearing on Problems of Cell Physiology, Genetics, and Differentiation"; Tracy M. Sonneborn, Indiana University, "Mechanisms Determining Persistent Intraclonal Diversities in Paramecium"; Jean Brachet, University of Brussels, Belgium, "Biochemical and Physiological Interrelations Between Nucleus and Cytoplasm"; Armin C. Braun, Rockefeller Institute for Medical Research, "The Physiology of Tumor Inception in Crown Gall Disease of Plants"; Alexander Haddow, Chester Beatty Research Institute, Royal Cancer Hospital, London, "The Mode of Action of Chemical Carcinogens, and Its Possible Relation to the Origin of Viruses"; and Hermann Lisco, University of Chicago, "The Relation of Atomic Energy to the Pathology of Growth and Development." Further information may be obtained from Walter Landauer, University of Connecticut, Storrs, Connecticut.

The New England Association of Chemistry Teachers extends a cordial invitation to teachers of science to attend the 9th Summer Conference at Wellesley College, August 18–23. The program features two symposia, one on Development of Atomic Structure, under the chairmanship of Alfred S. Brown, Colgate University, and another on Selected Topics From Introductory Chemistry, with Hubert N. Alyea, Princeton University, as chairman. Other papers to be presented include: "Science Fights in the Front Lines," Charles E. Waring, University of Connecticut; "New Chemical Processes of Interest to Chemistry Teachers," Emil R. Riegel, University of Buffalo; "The College Board Examinations," William W. Turnbull, CEEB; "European Problems," Samuel Van Valkenburg, Clark University; "Metal Hydrides," representative of Metal Hydrides, Inc.; "Minerals, Fun and Profit," John B. Lucke, University of Connecticut; "Role of Chemistry in the Treatment of Modern Textiles," Donald H. Powers, Monsanto Chemical Company; "*Drench* and Fire Control," Mr. Parker, Arnold, Hoffman & Company; "Crystal Structure," Charles Stillwell, Dennison Manufacturing Company; "Fluorine and Tooth Decay," Joseph F. Volker, Tufts College Dental School; "Acetyl Derivatives of 3,5-Dichlorosulfanilamide," Margaret K. Seikel, Wellesley College; "Commercial Production of Fluorine and Its New Uses," John T. Pinkston, Harshaw Chemical Company; "Flight Over Bikini," Royal M. Frye, Boston University; "Recent Developments in Powder Metallurgy," Alden M. Burghardt, Watertown Arsenal; and "Glass for Science" (motion picture), representative of Corning Glass Works.

Information concerning registration and accommodations can be obtained from the registrar of the Summer Conference Committee: Pearle R. Putnam, Dean Academy and Junior College, Franklin, Massachusetts.

Elections

The Kansas Academy of Science elected the following officers for 1947–48 at its annual meeting at Lawrence, Kansas: J. C. Peterson, Kansas State College, president; F. W. Albertson, Ft. Hays Kansas State College, president-elect; Paul G. Murphy, Kansas State Teachers College, Pittsburg, vice-president; F. C. Gates, Kansas State College, secretary; S. V. Dalton, Ft. Hays Kansas State College, treasurer; A. B. Leonard, University of Kansas, P. S. Albright, University of Wichita, and A. C. Carpenter, Ottawa, Executive Council members; D. J. Ameel, Kansas State College, librarian; Robert Taft, University of Kansas, editor of *Transactions;* W. H. Schoewe, University of Kansas, associate editor, geology; and F. C. Gates, Kansas State College, associate editor, botany.

The 79th annual meeting was presided over by Claude W. Hibbard, who also gave the retiring presidential address on "Pleistocene Vertebrate Faunas of Kansas." A public address was given by Waldo Wedel, U. S. National Museum, on "Prehistory and the Missouri Basin Development Program (see Summer Programs, *News and Notes*).

The Academy is scheduled to meet at Pittsburg, Kansas, in 1948; at Manhattan, Kansas, in 1949; and at Wichita, Kansas, in 1950.

The Chicago Academy of Sciences, at its 90th annual meeting, May 12, elected the following officers for the coming year: Nathan Smith Davis, president; William F. Henderson, first vice-president; Leslie Brainerd Arey, second vice-president; Hulburd Johnston, secretary; Herbert Edwin Bradley and Louis Ellsworth Laflin, Jr., new trustees; and William E. Powers, scientific governor.

NRC News

Fellowships and Senior Fellowships in Cancer Research, supported by the American Cancer Society and administered for the Society by the Committee on Growth of the NRC, are offered for advanced training and experience in any field of investigation pertaining to the problem of cancer, including the various biological, chemical, and physical sciences and clinical investigative medicine. Senior Fellowships are intended for men or women who already have demonstrated unusual competence in research and are designed to provide an opportunity for a prolonged period of advanced training in the field of growth. Their tenure ordinarily is three years. In occasional instances, predoctoral fellowships also have been awarded.

Twenty-four fellowships have been awarded for the year 1947-48, and five have been renewed. In addition, four fellows, awarded Senior Fellowships during 1946, will be serving their second year during 1947-48. The recipients are:

Christian B. Anfinsen, Jr., Boston, Massachusetts, to work on protein synthesis in normal and pathological tissues at the Medical Nobel Institute, Stockholm, Sweden (Senior Fellowship).

Narcisse R. Bothereau, South Pasadena, California, to work on the problem of the early diagnosis of cancer at the University of California Medical School, San Francisco.

Joseph H. Burchenal, Milford, Delaware, to work on new methods in the chemotherapy of cancer at Memorial Hospital, New York City (Senior Fellowship).

Thomas H. Coleman, Madison, Wisconsin, to work on the biology of thyroid tumors at the Massachusetts General Hospital, Boston.

Clarence M. Connelly, Ithaca, New York, to work in biophysics at the University of Pennsylvania, Philadelphia (Predoctoral Fellowship, renewal).

Arthur R. T. Denues, Bruceton, Pennsylvania, to carry on biological research at the Massachusetts Institute of Technology.

George C. Escher, New York City, to work on newer methods in cancer therapy at Memorial Hospital, New York City.

Peter Flesch, Chicago, Illinois, to work on the metabolism of human skin in relation to malignancy at the University of Chicago.

Howard Gest, St. Louis, Missouri, to work in the field of enzyme chemistry at Washington University, St. Louis (Predoctoral Fellowship).

Allan L. Graffin, Cambridge, Massachusetts, to work on problems of quantitative cytochemistry at the College of Physicians and Surgeons, Columbia University (Senior Fellowship).

Richard M. Halpern, Los Angeles, California, to work on the immunological aspects of cancer at Memorial Hospital, New York City.

Charles M. Huguley, Atlanta, Georgia, to work on newer methods in the chemotherapy of the leukemias and related blood disorders at the University of Utah Medical School, Salt Lake City (renewal).

William McK. Jefferies, Richmond, Virginia, to work on the biology of thyroid tumors at the Massachusetts General Hospital.

Nathan Kaliss, New York City, to work on the genetic aspects of cancer at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine (Senior Fellowship).

Fred Karush, Elmhurst, New York, to work on the specificity of protein interactions at New York University College of Medicine, New York City (Senior Fellowship).

Roger A. Lewis, Bethesda, Maryland, to work on the influence of hormones upon growth and development at Johns Hopkins University School of Medicine, Baltimore (Senior Fellowship).

Saul Malkiel, Brookline, Massachusetts, to work on the immunochemistry of viruses at the Rockefeller Institute for Medical Research, Princeton, New Jersey (Senior Fellowship, second year).

Robert C. Mellors, Rye, New York, to work on the endocrine and histochemical aspects of cancer at Memorial Hospital, New York City (Senior Fellowship).

William L. Money, Cambridge, Massachusetts, to work on factors influencing the release and action of the thyroid-stimulating hormone at the Massachusetts General Hospital.

James J. Nickson, Chicago, Illinois, to work on radiation therapy of cancer at Memorial Hospital, New York City (Senior Fellowship).

David Pressman, Los Angeles, California, to work on the immunochemistry of normal and malignant tissues at the California Institute of Technology, Pasadena (Senior Fellowship, second year).

Paul B. Reaser, New Orleans, Louisiana, to work on the use of isotopic tracers in biological research at Tulane University, New Orleans (Senior Fellowship).

John M. Reiner, St. Louis, Missouri, to work on problems of enzyme synthesis at Washington University, St. Louis.

Robert L. Sinsheimer, Cambridge, Massachusetts, to work in the field of biophysics at the Massachusetts Institute of Technology (Predoctoral Fellowship, renewal).

Wilson R. Slaunwhite, Winthrop, Massachusetts, to work in the field of organic chemistry at the Massachusetts Institute of Technology (Predoctoral Fellowship, renewal).

Arnold H. Sparrow, Cambridge, Massachusetts, to work on the use of tracer methods in cytological studies at the Massachusetts Institute of Technology (Senior Fellowship).

Morris A. Spirtes, New York City, to work on the chemotherapy of cancer at Johns Hopkins University School of Medicine, Baltimore.

Lotti M. Steinitz, New York City, for a cytophysiological study of growth in plants at the University of Wisconsin.

Henry J. Tagnon, Brookline, Massachusetts, for a clinical study of cancer patients at Memorial Hospital, New York City (Senior Fellowship, second year).

Timothy R. Talbot, Bala Cynwyd, Pennsylvania, to work on the use of tracer techniques in the study of blood diseases at Evans Memorial Hospital, Boston (renewal).

Irving A. Tittler, Brooklyn, New York, to work on the effects of carcinogenic

Hopkins Marine Station of Stanford University, Pacific Grove, California.

Richard B. Turner, New Haven, Connecticut, to work on the synthesis of steroid hormones at Harvard University (Senior Fellowship, second year).

Donald B. Zilversmit, Oakland, California, to work on phospholipid synthesis by animal tissues in normal and pathological states at the University of California, Berkeley (Predoctoral Fellowship).

The membership of the Committee on Growth is as follows: C. P. Rhoads, Memorial Hospital, chairman; Willard M. Allen, Washington University; R. Keith Cannan, New York University; A. R. Dochez, Columbia University; E. Newton Harvey, Princeton University; Charles Huggins, University of Chicago; Frank B. Jewett, National Academy of Sciences; Allan T. Kenyon, University of Chicago; C. C. Little, Roscoe B. Jackson Memorial Laboratory; Perrin H. Long, Johns Hopkins University; John J. Morton, Jr., University of Rochester; James B. Murphy, Rockefeller Institute; Eugene P. Pendergrass, University of Pennsylvania; John M. Russell, The John and Mary R. Markle Foundation; Florence R. Sabin, member emeritus, Rockefeller Institute; E. W. Sinnott, Yale University; M. A. Tuve, Carnegie Institution of Washington; and M. C. Winternitz, Yale University. Drs. Rhoads, Cannan, Harvey, Kenyon, Long, and Tuve and Mr. Russell serve also as a Fellowship Section, of which the latter is chairman.

Recent Deaths

Charles H. Taft, 56, associate professor of pharmacology, University of Texas School of Medicine, died suddenly in his office of cerebral hemorrhage on April 3.

Julio Cesar Tello, 67, director, Peruvian Archaeological Museum, and professor of archaeology and anthropology, San Marcos University, died June 4.

Jules Charles Abels, 33, cancer research specialist and assistant attending physician, Memorial Hospital, Center for Cancer and Allied Diseases, died June 13 of a heart ailment in his home in New York City.

Arthur J. Walscheid, 72, founder and chief gynecologist, North Hudson Hospital, Weehawken, New Jersey, died June 14 in the hospital after a brief illness.

Jean Capart, 70, onetime director of the Brussels Royal Museums of Art and History, Belgium, and advisory curator of Egyptology at the Brooklyn Museum, died June 16 in Brussels.

F. E. Chidester, 62, consultant in nutrition and endocrinology, and formerly professor, Extension Division, New York State College of Forestry, Syracuse, New York, died suddenly June 19 in Newark Valley, New York.

Many works of Mayan art spanning seven or eight centuries have been recovered from burials in a single mound near the village of Nebaj, in the little-known northern highlands of Guatemala, by archaeologists of the Carnegie Institution of Washington during excavations recently brought to an end by the onset of the rainy season. Included among the finds are a jadeite plaque or breast ornament, the finest example of Maya jade carving yet discovered; an urn with a human head on the cover; pendants of jade; a perfectly shaped thin alabaster jar; a vase of plumbate pottery; an elaborate pottery whistle; and many other items of value. All of the artifacts and works of art discovered at Nebaj this year have been placed in the Guatemala National Museum, Guatemala City, in accordance with agreements between the Government of Guatemala and the Carnegie Institution. The investigation is contributing valuable knowledge of the Maya, whose position as the most brilliant exponent of higher aboriginal culture in the western world in the days before Columbus is uncontested.

The American Mathematical Society will publish the Collected Mathematical Papers of the late George David Birkhoff. The Papers, totaling approximately 1,800 pages, will be published in three quarto-size volumes by the photo-offset process. A tentative price of $18 has been set for the three volumes. Members of the Society making a prepublication subscription will be offered a 30 per cent discount. Contributions and subscriptions are urgently needed at this time to assure the success of the project. The Society will begin publication when $6,000, half the estimated cost of publishing, has been pledged. Contributions and prepublication subscriptions should be sent to J. R. Kline, Secretary, American Mathematical Society, University of Pennsylvania, Philadelphia 4, Pennsylvania.

The Imperial Bureau of Pastures and Forage Crops, Great Britain, has become the Imperial Bureau of Pastures and Field Crops, directed by R. O. Whyte. In its expanded form, it will publish a second abstracting journal, in addition to *Herbage Abstracts*, and will cover literature on the following crops not already covered by the Bureaus of Plant Breeding and Genetics, or Soil Science: all cereals, field root crops, pulses, groundnuts, cotton and other fiber crops grown on a field scale, sugar beets and sugar cane. Continued attention will be given to those aspects of plant biological research which refer to the crops now covered. Research workers, institutes, and departments are invited to send their publications and reports concerned with these crops to the Bureau of Pastures and Field Crops, Penglais, Aberystwyth, Wales, England, for review in the new abstracting journal.

UNESCO is distributing a collection of files of scientific periodicals which was offered by the University of the Witwatersrand, Johannesburg, South Africa, among war-devastated libraries of Europe. Twenty-six sets of these periodicals have now been allocated to eight libraries in Belgium, Denmark, and Poland.

The New York Botanical Garden announces the appointment of P. P. Pirone, associate professor of plant pathology, Rutgers University, as plant pathologist, succeeding B. O. Dodge. Richard A. Howard will also join the staff August 1 as assistant curator, specializing in tropical botany. Donald Philip Rogers, University of Hawaii, will become curator in the cryptogamic herbarium September 1.

The Korean Society for Scientific Agriculture was organized June 7, 1947 at Seoul, Korea. Active membership in the Society is open to graduates in agriculture, forestry, sericulture, and fisheries, and to persons who have made outstanding contributions to agriculture and the associated sciences. H. K. Lee, director, Department of Agriculture, was elected chairman and V. H. Florell, chemicals on growth in protozoa at the agronomist, U. S. Military Government in Korea, vice-chairman. Branch societies, one each in Kyonggi Do and Kang Won Do provinces, were organized earlier and have been holding regular meetings.

The New York Academy of Medicine has recently organized a Section on Microbiology. The main objectives of this section will be the encouragement of the exchange of information among microbiologists and the promotion of ready contacts between clinical and laboratory investigators. The Fellowship of the section will be broad, including not only those who have a direct interest in microbiology, but also those who deal with microbiology in their primary functions as clinicians or scientists in other branches. The officers of the new section are: Gregory Shwartzman, Mount Sinai Hospital, chairman; Harry Most, New York University College of Medicine, secretary; and René J. Dubos, Rockefeller Institute for Medical Research, Frank L. Horsfall, Jr., Rockefeller Institute for Medical Research, Colin M. MacLeod, New York University College of Medicine, Ralph S. Muckenfuss, Research Laboratories, New York City Health Department, and John G. Kidd, Cornell Medical College, advisory committee.

Chicago Natural History Museum has acquired a large and important collection of plants from Ecuador, assembled and presented by M. Acosta Solis of that country. According to Julian A. Steyermark, assistant curator of the herbarium, this is the largest collection from Ecuador so far received by any institution. It is also one of the largest from a South American country to have reached the Museum.

Make Plans for—

Fifth International Pediatrics Congress, July 14–17, Waldorf-Astoria Hotel, New York City.

Symposium on Sound, July 21–22, University of Utah, Salt Lake City.

Conference on Algebra, July 25–28, University of Michigan, Ann Arbor.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS *by Readers*

Perhaps no words are more often used incorrectly by systematists and their colleagues than *availability* and *validity.* The words are often erroneously used interchangeably and even with still a third meaning. Actually, three clear-cut concepts are involved: (1) simple proposals of names, whether in compliance with "legal" requirements or not; (2) "legally" acceptable proposals; and (3) "legally" acceptable proposals which can be recognized. An understanding of these concepts and the proper expression for each would greatly simplify and clarify nomenclatural discussions. The frequency with which they are inadequately distinguished has led to almost endless confusion.

For example, all of the following are occupied: *Scincus americanus* Petiver 1711, *Henicognathus annulata cyclura* Cope 1886, *Coluber novae Hispaniae* Gmelin 1788, *Bascanium semilineatum* Cope 1891, *Coluber arizonae* Boulenger 1894, and *Salvadora grahamiae* Baird and Girard 1853. All have been published in journals or books generally available to the public. Accordingly, *any name, once published, is occupied;* it may be available and/or valid or not.

However, *Scincus americanus* Petiver 1711, *Henicognathus annulata cyclura* Cope 1886, and *Coluber novae Hispaniae* Gmelin 1788 are not available (and therefore cannot be valid), since each violates at least one requirement of the International Rules of Zoological Nomenclature. The first name is pre-Linnaean (acceptable names must have been proposed after January 1, 1758); the second is a *nomen nudum* (no diagnosis or definition accompanied the name); and the third is not binomial (acceptable names must be proposed in a binomial system of nomenclature, although they may be trinomial). *Any name published in accordance with the International Rules of Zoological Nomenclature is both occupied and available,* whether valid or not.

Of the remaining names, only *Salvadora grahamiae* Baird and Girard 1853 is valid; it was properly proposed and is a synonym of no other name. *Bascanium semilineatum* Cope 1891 is a zoological synonym of *Masticophis bilineatus* Jan 1863, and *Coluber arizonae* Boulenger 1894 is a nomenclatural synonym of *Arizona elegans* Kennicott 1859. *Only an available name whose "title" to a species is clear* (*i.e.* which is neither a synonym nor a homonym of an earlier name) *can be valid.*

It is obvious that, at any one time, there can be only one valid name for a species, although there may be several available names and even more occupied names. Likewise, it is apparent that while all available names are occupied, not all occupied names are available. (HOBART M. SMITH, *Department of Zoology, University of Illinois, Urbana.*)

Recently, Traub and Slattery (*Plant Physiol.*, 1947, **22**, 77–87) observed that the invertase of bottom fermentation yeast differed markedly from that of top yeast in the effectiveness with which it hydrolyzed the levulins in the residue of the 89 per cent ethanol extract of guayule plants, *Parthenium argentatum* A. Gray. It is of interest to compare this observation on the hydrolysis of levulins with reports of earlier work with inulin in which it had been stated that enzymic hydrolysis of inulin [β-D-furanofructosidase activity] was an aspect of the invertase (sucrase or saccharase) of autolyzed yeast (Lindner. *Wschr. Braeu.*, 1900, **17**, 713–716, 762–765; Kuhn. In Hoppe-Seyler's *Z. physiol. Chem.*, 1923, **129**, 59–63; and especially Weidenhagen, as cited by Bamann and Myrbraeck in *Die Methoden der Fermentforschung*, 1940, p. 1900). Weidenhagen identified inulase as β-h-fructosidase, although he found that his preparation hydrolyzed sucrose 5,000 times as actively as it did inulin.

The data presented by Traub and Slattery show that under the experimental conditions top invertase hydrolyzed from 30 to 65 per cent more of the levulins present than were similarly hydrolyzed by bottom invertase. The ratio of the two kinds of activity in invertase preparations from top fermentation yeast differed from the analogous ratio from bottom yeast by that amount. Hence, it is probable that each preparation is a mixture of enzymes among which are a sucrase and a β-D-furanofructosidase, but not in the same proportion. It is, of course, by no means certain that "invertases" of top and bottom fermentation yeast from any other source would have the same composition or activity as that used here. Plant physiologists were warned as early as the first quarter of the present century that commercial invertase preparations may split other polysaccharides (*i.e.* melibiose) than sucrose and raffinose (Hudson, and Hudson and Harding. *J. Amer. chem. Soc.*, *1914*, **36**, *1570*; *1915*, **37**, *2193–2198*). Thus, after treatment with commercial invertase, unless the other possibilities are disposed of, a reducing power may be found and reported as sucrose or raffinose, when actually the sugar reported may not be present at all (cf. McRary and Slattery. *J. biol. Chem.*, 1945, **157**, 161–167). That this effect is due to the presence of more than one enzyme is indicated by the present work and by that of Zechmeister, Tóth, Fuerth, and Bársony (*Enzymologia*, 1941, **9**, 155), Adams, Richtmeyer, and Hudson (*J. Amer. chem. Soc.*, 1943, **65**, 1369–1380), and Pigman (*J. Res. nat. Bur. Stand.*, 1943, **30**, 159–175).

The top and bottom invertases used in the experiments were purchased from the Wallerstein Laboratories, 180 Madison Avenue, New York 16, New York. (HAMILTON P. TRAUB, E. L. GREEN, and M. C. SLATTERY, *Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.*)

Schizophrenia strikes 1 or 2 per cent of the population of the United States, mostly those between 15 and 35 years of age. (An exact figure of the incidence of schizophrenia in the general population has not been obtained. Kallman uses .85 per cent. But, as he states that 20 institutions in the state of New York in 1945 had 72,252 patients, of which 47,929 were schizophrenics and 12,316 new admissions, and as a report by Pollock, Malzberg, and Fuller (*Hereditary and environmental factors in the causation of manic-depressive psychoses and dementia praecox.* Utica, N.Y.: State Hospital Press, 1939) indicates that some 4.5 per cent of the population will be hospitalized some time in their lives because of mental disease, it seems not unreasonable to suppose that the incidence of schizophrenia in the general population may reach 2 per cent.) A large proportion of these 1,400,000 to 2,800,000 unfortunate people require care in public institutions for the remainder of their lives. What causes all this misery? Does it arise from external causes or from within?

A great deal of light is thrown on these questions by two studies which are not likely to come to the attention of *Science* readers by reason of their places of publication. These studies were made by Franz J. Kallman, using the "Twin Family Method." The first of these is a book of nearly 300 pages (*The genetics of schizophrenia.* New York: J. J. Augustin, 1938). That it has not received the attention it deserves may be due to the large amount of pertinent accessory material, which tends, nevertheless, to discourage perusal. The second is of recent publication (*Amer. J. Psychiat.*, 1946, **103**, 309).

Both studies have been made with meticulous care. The first is on 1,087 schizophrenics and their relatives, covering in all 13,851 persons. The second is based on 174 pairs of monozygotic (one-egg) twins and 517 pairs of dizygotic twins and 4,394 other relatives. The material is, therefore, statistically reliable. Together they present a thoroughly comprehensive picture of the role of heredity in the etiology of schizophrenia, by showing that the incidence of schizophrenia among relatives of schizophrenics increases directly as the degree of biological relationship increases. Thus, the incidence of schizophrenia among step-sibs—which usually are not biologically related to the schizophrenic—is 1.8 per cent; in half-sibs, 7.0 per cent; in full sibs, 14.3 per cent; and in dizygotic twins, 14.7 per cent. (The incidence of schizophrenia in the co-twins of dizygotic pairs of the same sex is 17.4 per cent for males and 17.6 per cent for females, as against 10.3 per cent for twins of opposite sex. This may perhaps be referred to differences in environment associated with sex.) In monozygotic twins it rises to 85.8 per cent

In examining these statistics, it is to be understood that the question answered is: Given a schizophrenic, how many schizophrenics are found among relatives of a given degree of biological relationship? Thus, in the case of twins, there being only one relative of the degree named, the question becomes: What proportion of the co-twins develop schizophrenia? The contrast in the incidence of schizophrenia in the co-twins of schizophrenic monozygotic twins and those of schizophrenic dizygotic twins is plain evidence of the predominating part played by inheritance in the etiology of schizophrenia. This contrast can arise only because both twins of a monozygotic pair are guided in their development by identical sets of genes, while the genes of dizygotic twins differ in exactly the same way that the genes of ordinary sibs differ.

The failure of a small proportion of the co-twins of the monozygotic twins to develop schizophrenia indicates that, under favorable circumstances (environment), a person with the inheritance for schizophrenia may not reach the clinical or hospitalization stage. Nevertheless, with a single exception, all co-twins in Kallman's series of monozygotics showed evidence of their schizophrenic constitution by those personality characteristics which are called schizoid by psychiatrists. All in all, then, it appears that schizophrenia develops only in persons of a certain genetic constitution. (H. D. GOODALE, *257 West Main Street, Williamstown, Massachusetts.*)

In connection with the 4th Microbiological Congress being held in Copenhagen this month, Michael Heidelberger, president, American Association of Immunologists, has forwarded to *Science* a letter written by Ludwik Hirszfeld of Wroclaw to Thorvald Madsen of Copenhagen. According to the letter, during the German occupation 2,000 Polish scientists and physicians were murdered, many of them having died as a result of experimental operations; two of the leading bacteriologists, Prof. Fleck and Privatdozent Mayzel, "were obliged to work in the laboratory of concentration camps"; and Polish universities were closed for the duration of the occupation, most of the books and apparatus having been removed to Germany with the assistance of German professors. Prof. Hirzfeld, who himself survived the occupation by hiding under a foreign name, concludes: "And so we hope that the Danish scientists will understand that we have no right and no intention to forget and that we don't wish to meet those whom we consider as actively or passively responsible for these crimes."

T E C H N I C A L   P A P E R S

On the Geochemistry of Columbium

KALERVO RANKAMA[1]

Saratoga Springs, New York

In an earlier paper the present author (*8*) has discussed the geochemistry of tantalum, in this respect, thus far, one of the more imperfectly known elements. Later an investigation of the geochemistry of columbium was carried out, based on substantially the same material. The present paper is a condensation of the results obtained.

The laboratory work was carried out in the Geochemical Laboratory, Institute of Geology, University of Helsinki, Finland. The Cb contents of the samples were determined by means of spectrochemical analysis, using a new, previously described technique (*10*).

There are some 30 to 40 species which can be classified as Cb minerals proper. Columbite and tantalite are the most common of the species in question. In minerals, Cb is found to replace Ta diadochically and to enter in a number of Ti-, Zr-, Sn-, and W-bearing, and in small amounts in Cr- and Mn-bearing, minerals. The content of Cb in certain minerals and mineral groups is presented in Table 1, which also contains information furnished by von Hevesy, Alexander, and Würstlin (*5*), Borowsky and Blochin (*1*), Panteleyev (7), and Sahama (*11*).

TABLE 1

	Cb_2O_5 (max. %)
Titanium minerals:	
Titanomagnetite	0.055
Ilmenite	1.3
Perovskite	4.7
Rutile	0.29
Anatase	0.067
Brookite	0.033
Sphene	3.3
Keilhauite	1.2
Zirconium minerals:	
Zircon	2
Woehlerite	>5
Astrophyllite	2.15
Eudialite	2.35
Eucolite	4.0
Catapleiite	2.2
Other minerals:	
Magnetite	0.026
Cassiterite	3.4
Wolframite	>5
Garnet group	0.001
Thorite	0.31
Tourmaline group	0.007
Thortveitite	0.95
Pyroxene group	0.013
Amphibole group	0.016
Muscovite	0.033
Biotite	0.188

As is known from work of previous investigators, the cassiterites sometimes contain high amounts of Cb. According to Goldschmidt (*4*), this fact is due to the presence of Sc and Fe columbates, $ScCbO_4$ and $FeCb_2O_6$, in the cassiterite. The electric balance is maintained by the simultaneous addition of one Sc^{3+} to every Cb^{5+} or of one Fe^{2+} to every two Cb^{5+}. Also, in wolframite $ScCbO_4$ is responsible for the presence of Cb. In Ti minerals Cb is found to replace Ti, being captured in place of this element. Some of the magnetites investigated contain traces of Cb, evidently due to the presence of small amounts of Ti in the lattice. The occurrence of Cb in Zr minerals and perhaps also in thorite is explained in a similar way.

As is shown by Sahama (*11*), Ca must be replaced by Na in sphene to maintain the electrostatic neutrality of the lattice if Ti is replaced by Cb. This rule may be extended to cover such minerals as garnet, tourmaline, the pyroxenes, and the amphiboles. The high Cb content of thortveitite is interesting and might lead to a re-examination of the chemistry of this mineral.

TABLE 2

	Cb_2O_5(%)	Cb:Ta
Monomineralic rocks	0.00004	0.4
Ultrabasic rocks	0.0023	16.4
Eclogites	0.0005	5.3
Gabbros	0.0027	17.7
Diorites	0.00052	5.5
Granites	0.003	5.0
Syenites	0.005	17.1
Nepheline syenites	0.045	384.1
Basic alkaline rocks	0.002	11.4

The micas, muscovite and biotite, contain appreciable amounts of Cb, for which there is adequate room in the capacious mica lattice. It is also evident that in biotite Cb can replace Ti. Rather high Cb_2O_5 contents are reported by Stevens (*14*) to occur in lepidolites, the maximum being 1.52 per cent in a polylithionite from Greenland.

In addition, small traces of Cb varying from some thousandths to some millionths of a per cent, are occasionally found in many sulfides, e.g. sphalerite, chalcopyrite, galena, and pyrite; the carbonates, siderite and calcite; anhydrite; scheelite; monazite and apatite; vanadinite; olivine, kyanite, topaz, beryl, nepheline, the feldspars; and still other minerals. In these cases, the adsorption of Cb compounds, such as soluble alkali metacolumbates $NaCbO_3$ and $KCbO_3$, is suggested as the cause of the contamination, in the sense extensively studied by Seifert (*12, 13*).

The third group of minerals includes: halides; corundum, hematite, quartz; barite, gypsum; cordierite, talc, antigorite, leucite; most of the feldspar minerals investigated; and many other species which were found to be free from Cb.

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The Cb contents of the different groups of igneous rocks, together with the Cb: Ta ratios, are presented in Table 2.

A remarkably high Cb content is found in ultrabasic rocks, comparing well with the average content in granites. This is evidently due to the high Ti content of these rocks, and we deal here with the replacement of CaTi by NaCb, which is, according to Niggli (*6*), responsible for the separation of Cb from the magma at a relatively early stage. Similar causes might well be responsible for the high content of this element in gabbroio rocks. In granites the concentration of Cb in the residual liquors will become evident, but the highest contents are arrived at in syenites and nepheline syenites. In this respect Cb clearly differs from Ta, which shows a maximum in granites. These results are in accordance with the observations of Goldschmidt (*2*) that both Cb and Ta are elements characteristic of granite pegmatites, while the latter element, contrary to Cb, is a less pronounced denizen of nepheline syenite pegmatites. This is clearly seen also by the Cb:Ta ratios of the two rock classes.

TABLE 3

	Cb_2O_5(%)	Cb:Ta
Minerogenic sediments	0.0018	9.0
Chemical "	0.00006	2.6
Organogenic "	0.00009	3.8
Deep sea "	0.0059	41.9

The Cb contents for sedimentary rocks are given in Table 3. As in igneous rocks, Cb in sedimentary rocks is more common than Ta. It is of interest to note the concentration of Cb in hydrolysate sediments in the beginning of the exogeneous cycle, and its even more pronounced concentration in the deep sea sediments, where the highest amounts are present in the manganese nodules.

No figures will be offered with respect to metamorphic rocks, since the geochemistry of metamorphism is, as yet, known very incompletely.

TABLE 4

	Cb_2O_5(%)	Cb:Ta
Silicate meteorites	0.000072	1.3
Meteoric irons	0.000029	3.5

The Cb contents of the meteorites are presented in Table 4 As may be seen, the amounts present are quite low.

The occurrence of Cb in mineral lattices has already been discussed. The main results are that Cb and Ta are mutually camouflaged in many minerals and that, in the mineral kingdom, Ti and Zr are the most powerful carriers of these elements. Both Cb and Ta are true satellites of Ti. As Cb is quite widely distributed in minerals, it may also be considered a quite mobile element.

By the study of the occurrence of Cb in different mineral groups and rocks the concentration of this element can be followed toward the end of magmatic crystallization. A fine example of the growing concentration of Cb with the proceeding differentiation is afforded by a series of analyses from Lapinlahti, Finland (Table 5).

During the exogeneous differentiation, a large proportion of Cb is accumulated in the hydrolysate sediments at a comparatively early stage. It may be pointed out that the average content of Cb_2O_5 in Baltic clays (0.003 per cent) is equal to the Cb average in granites. Some Cb, quite naturally, is always present in transported deposits, due to the hardness and resistance to chemical decomposition of the minerals in question. In hydrolysates the highest Cb contents are found in bauxites and laterites.

Another part of Cb is present in sea water, perhaps as a soluble alkali columbate, as is seen by its presence in marine carbonate sediments and in anhydrite. Cb is finally deposited in the deep sea sediments, the manganese nodules being especially rich in this element. This is one minor phase in the universal depoisoning of ocean water.

TABLE 5

Lapinlahti rocks	Cb_2O_5(%)
Bytownite rock	0
Hornblendite	0
Olivine gabbro	0.000008
Bytownite gabbro	0.00009
Gabbro	0.0007

The presence of Cb in certain biological substances seems to point to the possibility that this element might be able to form organometallic compounds.

All collected evidence of the general geochemical character of Cb emphasizes the purely lithophile character of this element. In addition, it belongs to the group which, on a previous occasion, has been named "granitophile" (*9*).

The average Cb content in igneous rocks is given in Table 6, together with the corresponding Ta values and the Cb:Ta ratio. The value for Cb is in close agreement with a previous average (0.002 per cent) given by Goldschmidt (*3*).

A few words may be added on the concentration of Cb in mineral deposits of economic importance. Nigeria is the most important present-day source of columbite high in Cb. This element has received considerably more attention since 1936, because of the demand of the stainless and alloy steel industries for columbite free from Ta.

TABLE 6

Cb_2O_5(%)	0.0034
Cb (%)	0.0024
Ta_2O_5(%)	0.00026
Ta(%)	0.00021
Cb:Ta	11.4

The study of the regional geochemistry of Cb reveals the concentration of this element in some local and areal centra, while other regions and geological units are known which are nearly or completely devoid of this element. In this respect the behavior of Cb is similar to that of Ta. The occurrence of Cb in the Pre-Cambrian granite groups of Finland offers results of considerable interest. There is, as in the case of Ta, a secular increase in the amount of Cb toward the geologically younger granites. However, the Post-Archean rapakivi granites form a break in this rule: they form a coherent group, independent by their geological occurrence and by their petrological, chemical, and geochemical properties.

The geochemical comparison between Cb and Ta manifests that Cb is the more common and more abundant of the two. With the use of the abundance number of Cb in igneous rocks, one can approach the question of whether or not this element follows the rule of Oddo and Harkins, according to which the elements with odd atomic number are more rare than their neighboring elements which flank them in the Periodic Table. Thus, we should expect that Cb is less abundant than Zr and Mo. The abundances of these three elements, expressed in grams per metric ton, are: Zr, 220; Cb, 24; Mo, 15. Cb most certainly does not follow the rule, but the cause of this deviation may probably be found in the too small value of Mo.

It may be stated, as a general rule, that Cb and Ta commonly occur together, and that minerals and rocks relatively high in one are also usually high in the other. Thus, these elements form a quite coherent pair, as can be expected from the similarity of their ionic radii (Cb^{5+}, 0.69A.; Ta^{5+}, 0.68A.), this being due to the lanthanide contraction, further, from the similarity of their ionic charges and of their ionic types. There is also a marked chemical similarity between these two elements. It could thus be expected that no pronounced separation between them would take place in Nature.

However, this pair is not too coherent, and it is inferior to the rare earths or to the pair Zr-Hf, as is shown by the fact that its component elements are quite often actually separated in Nature. It is even possible to find a geological unit, or area, where, in some minerals at least, the normally less abundant of these two elements predominates. Compared with the pair Zr-Hf, it is noted that geochemical camouflage is in no other case more pronounced than that of Hf by Zr. In conclusion, while easily capable of separating Cb and Ta, Nature is unable to separate Hf from Zr with her methods of analysis. This fact is reflected also in certain chemical features of these elements: no method of everyday chemical analysis is known which is suited for the determination of Hf in the presence of Zr, the separation of Hf from Zr being unexampled in difficulty. Cb and Ta, on the other hand, can be comparatively easily separated from each other by Marignac's method, and routine determinations of these elements by the ordinary methods of chemical analysis are carried out in many laboratories.

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Sensitivity of Grasses and Some Crop Plants to Isopropyl-N-Phenyl Carbamate

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It has been reported that some urethanes injure or kill grass plants when applied to soil in which the plants are growing (*1*, *2*). Greenhouse experiments were undertaken in October 1946 to study the sensitivity of various grasses to isopropyl-n-phenyl carbamate (IPC) and to compare their sensitivity to this compound with that of some dicotyledonous plants.

Seeds of grasses and dicotyledonous plants were sown in fertile potting soil to which known amounts of IPC were added.[1] In some experiments the carbamate was first mixed with a small amount of quartz sand, and this mixture was then added to soil and the seeds planted. In other experiments the carbamate-sand mixture was spread evenly on the surface of the soil after it had been potted and the seeds planted. The amount of sand used was 10 grams/pound of soil.

The IPC affected the growth of grass seedlings in varying degrees, depending on the method of application. When applied to the surface of soil at a rate equivalent to 2 pounds/acre (calculated on an area basis), IPC prevented the emergence of quack grass seedlings,[2] while 91 per cent of the seeds planted in comparable untreated soil emerged and grew vigorously. When the same amount of carbamate was worked into the upper 1 inch of soil, the treatment was less effective since 18 per cent of the quack grass seedlings emerged and grew vigorously. IPC applied at a rate equivalent to 2 pounds/acre and cultivated into soil to a depth of approximately 4 inches was even less effective in inhibiting the emergence of the seedlings.

TABLE 1

Emergence of Bluegrass and Crab Grass Seedlings*

Mg. IPC/ pound of soil	Bluegrass†		Crab grass	
	A	B	A	B
0.0	80	57	29	18
3.4	5	3	30	27
10.2	11	0	31	21
20.4	8	0	39	22
40.8	3	0	40	25

*Values represent average percentages of emergence in successive experiments, A and B. Four replications of each treatment (4 × 50 seeds) were used for each experiment.

†Although some bluegrass plants emerged in treated soil, they failed to grow more than ½ inch above the surface.

Differences in the sensitivity of grasses to IPC became apparent when crabgrass and bluegrass seeds were planted in soil containing known amounts of the chemical. Emergence of bluegrass seedlings was greatly reduced in soil that contained as little as 3.4 mg. of IPC/pound, while the emergence percentage for crab grass (*Digitaria sanguinalis*) increased with the addition of IPC to the soil (Table 1). Toole (*3*) has reported that the germination percentage for crab grass (*D. ischaemum*) was increased through the addition of nitrates. Although the emergence percentage of partially dormant crab grass was apparently stimulated by IPC in this experiment, the subsequent growth of the plants was greatly inhibited.

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[1] Compound furnished by J. T. Baker Chemical Company, Phillipsburg, New Jersey.

[2] Quack grass seeds furnished by O. M. Scott & Sons Company, Marysville, Ohio.

TABLE 2

SENSITIVITY OF SOME MONOCOTYLEDONOUS PLANTS TO IPC WHEN APPLIED TO THE SOIL AT A RATE EQUIVALENT TO 5 POUNDS/ACRE*

Plant	Emergence index	Plant	Emergence index
Bermuda grass....	130	Fescue..................	0
Amber sorghum..........	99	Ryegrass.......	0
Sudan grass.....	88	Redtop........	0
Millet.........	86	Timothy	0
Bluegrass....	4	Orchard grass..	0
Barley....	0	Quack grass...	0

*Values represent relative emergence from seeds planted in treated soil calculated on the basis that emergence in comparable untreated soil equaled 100 per cent.

On the basis of the emergence percentage of grass species tested, the effect of IPC when added to soil varied from complete inhibition in the case of quack grass, fescue, and others (Table 2) to stimulation of growth during the very early stages of development of Bermuda grass and crab grass (Tables 1 and 2). Applied at higher rates (30-60 pounds/acre), the effect of IPC on the growth of less sensitive species (sorghum, Sudan grass) was prolonged so that the plants grew above the surface of the soil for a distance of 1-3 cm. and then failed to develop further. Microscopic examination revealed that these plants remained alive but stunted after appearing above the surface. These stunted plants failed to produce seeds.

When IPC was applied at relatively high rates (50 and 100 pounds/acre) to potted soil in which crab grass had become established and had developed leaves extending about 1-2 cm. above the surface of the soil, the plants failed to grow further and died within a period of 2 weeks following treatment.

To observe the effect of the carbamate on the emergence and growth of such crop plants as sugar beets, table beets, carrots, radishes, onions, and spinach, seeds of these crops were planted, together with measured amounts of quack grass seeds, in soil to which different amounts of IPC were added. When applied evenly to the surface of the soil at the rate of 2 pounds/acre, IPC completely prevented the emergence of quack grass seedlings and only temporarily checked the growth of sugar beet seedlings which germinated from seeds planted in the same lot of treated soil (Fig. 1, Table 3). The emergence percentage for onions was not reduced by the presence of IPC in soil at rates of 2, 4, or 8 pounds/acre (Table 3). The growth of radishes was slightly less in soil treated at the rate of 2 pounds of IPC/acre than in untreated soil. The growth of spinach and table beets was not visibly affected by the application of the carbamate at the latter rate to soil in which the seeds were germinated and the plants grown for a period of 6 weeks.

TABLE 3

AVERAGE PERCENTAGES OF EMERGENCE FOR ONION AND SUGAR BEET PLANTED TOGETHER WITH QUACK GRASS IN SOIL TREATED WITH DIFFERENT AMOUNTS OF IPC*

Pounds IPC/acre	Onion	Sugar beet	Quack grass
0	46	76	98
2	69	69	0
4	59	83	0
8	68	66	0

*Carbamate applied to surface of soil at time seeds were planted.

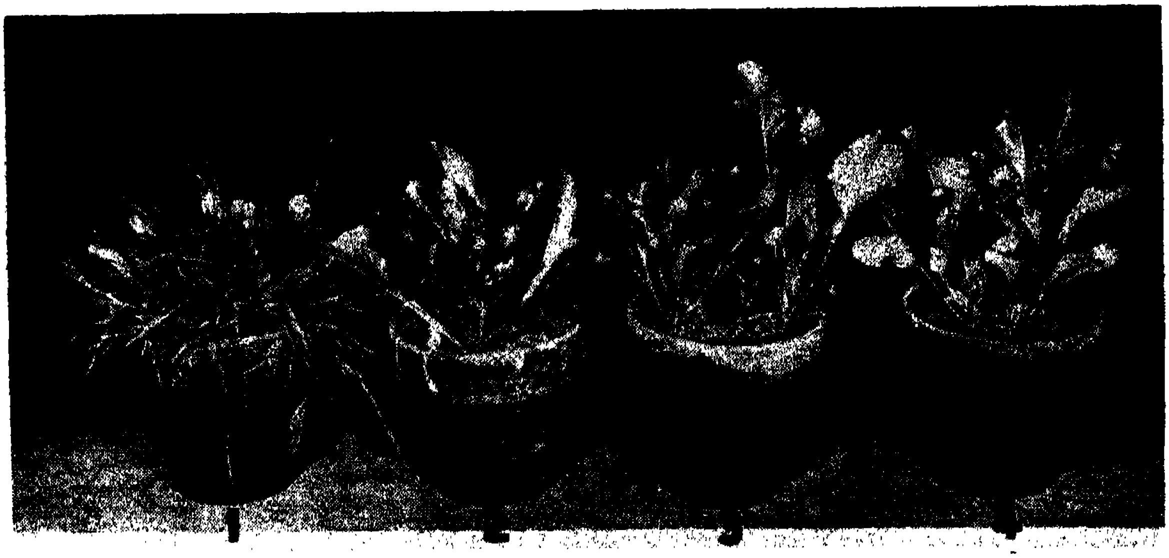

FIG. 1. Measured amounts of sugar beet and quack grass seeds planted together in potted soil. IPC applied to surface of soil immediately after planting at rates equivalent to (1) 0.0; (2) 2.0; (3) 4.0; and (4) 8.0 pounds/acre. Photographed 6 weeks after planting.

IPC is inactivated in the presence of moist, fertile soil (*1*), as is the case with 2,4-D. In testing for the inactivation of IPC, quack grass failed to survive when the seeds were planted in soil to which 40.8 mg./pound of soil had been freshly added.

Subsequent to this test the soil was kept moist in a greenhouse for a period of 2 months, at which time it was reseeded. Eighty-four per cent of the quack grass seeds germinated, and the plants grew vigorously and showed no symptoms of injury, indicating that the carbamate had been inactivated, possibly through the action of soil microorganisms.

The present results from greenhouse experiments indicate that isopropyl-n-phenyl carbamate may be useful in reducing the population of some weedy grasses, such as quack grass, which infest certain crop areas.

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Geomagnetic Control of F_2 Layer Ionization

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In a recent communication to *Nature* (*2*) the author has given a brief account of the results of a study of the world distribution of F_2 layer ionization. Such a study has only become possible in recent years, when, to serve the operational requirements of the Allied Forces, many new ionospheric stations have been set up in different parts of the world. The chief results which have emerged from this study of F_2 layer morphology can best be illustrated by considering the local noon values of critical frequency at the equinoxes, when the earth is symmetrically illuminated by the sun with respect to the geographic equator. From these values it has been deduced that (a) for a constant longitude, the noon values of ionization at the same numerical latitude, north and south of the equator, are not necessarily equal, and (b) there is a variation of noon ionization with longitude along a line of constant latitude. It will thus be seen that, according to these results, it is not possible simply to relate noon equinox values of critical frequency for the F_2 layer to the sun's zenith distance, as is possible in the case of the E and F_1 layers. An additional controlling factor has therefore been sought.

In Fig. 1 is plotted the relation between equinox noon F_2 layer critical frequency and magnetic latitude, using all the data now available to the author for March 1944. It will be seen that the anomalies mentioned above, which appear when ionization density is related to geographic latitude, have now substantially disappeared.

One of the most remarkable features of Fig. 1 is the trough of low values of ionization density centered on the geomagnetic equator. A study of the detailed ionospheric information available from stations between ±18° magnetic latitude shows that these low values are associated with a marked bifurcation of the F layer into its two components, F_1 and F_2. The phenomenon can thus be linked with others already identified previously in studies of the seasonal variation of F_2 layer noon ionization at Slough, England (lat. 51½°N.). In measurements made at that station it has been found that there is a remarkable difference between summer and winter conditions. In winter the F layer appears fairly homogeneous and the ionization density is high, whereas in summer, under conditions of reduced solar zenith distance, there is marked bifurcation of the layer into its two components and the ionization of the upper component (F_2 layer) is much reduced. Under such conditions of bifurcation the F_2 layer exhibits entirely different physical characteristics. The electron production rate at the layer maximum is much reduced, as is also the electron recombination coefficient. Moreover, the variation of ionization is no longer substantially symmetrical about noon, there being often a minor minimum at mid-day, the major maximum of the day occurring in the evening.

It is therefore found that the equinox phenomena experienced at stations situated between magnetic latitude ±18° are similar to those experienced at Slough in a northern summer, when the ionization in the F layer as a whole is distributed through a great range of vertical heights. On the other hand, the ionization maxima (Fig. 1), at ±18° magnetic latitude, are associated with a relatively thin homogeneous F layer without marked bifurcation.

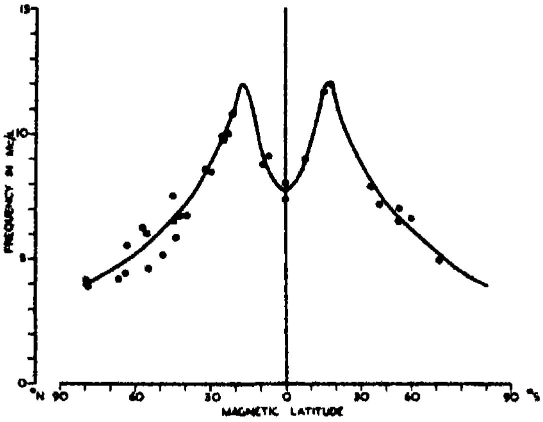

FIG. 1. Relation between equinox noon values of F_2 layer critical frequency and magnetic latitude.

The long-term study of F_2 layer ionization has shown that, as in the case of the E and F_1 layers (*3*), there is marked variation of ionization in sympathy with the trend of the sunspot cycle. Such a correspondence is most strikingly exhibited if ionization density is compared with calcium flocculi figures (*1*). But, in addition, the author has found that the ratio $\frac{N_{max.}}{N_{min.}}$, where $N_{max.}$ and $N_{min.}$ refer to noon ionization densities at sunspot maximum and minimum, respectively, is not constant at any station for each month in the year. For example, this ratio is approximately 4 for the summer months (May, June, and July) at Slough and approximately 2 for the winter months (November, December, and January). Such a variation indicates that either the intensity of the ionizing radiation or the atmospheric medium which is ionized varies throughout the year. A study of similar phenomena at a number of stations in addition to Slough suggests that it is the seasonal variation of the atmospheric medium which is substantially responsible.

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IN THE LABORATORY

Improved Cage Designs for Use in Handling Monkeys

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The use of monkeys as experimental animals has always been somewhat of a problem due to the difficulty in handling. This is particularly true of new or unused monkeys.

In this Laboratory the Rhesus monkey is used almost exclusively. Although the general stock is housed in a conventional animal house, those selected for tests are housed in the laboratory in large metal cages measuring approximately 28 x 31 x 40 inches. The lower half of the cage is enclosed with sheet metal, and the upper half and top with heavy, large-mesh screen. Underneath the floor, which consists of a removable panel of the same size screen as the top, is a removable pan for catching debris. The entire front of the cage may be opened by a large, side-hinged door. Two monkeys are usually housed in each cage, and the cages are set in tiers of two.

For some types of tests it is necessary to transfer the monkeys daily from the large cages to small individual cages for treatment. At regular intervals it is also necessary to remove the animals for venipuncture, etc. During these operations, which are difficult and time consuming, the animals formerly had to be transferred by hand and forcibly held quiet for the necessary blood work. Occasionally an animal would be injured or would escape and do considerable damage before being caught.

The following is a description of the cages and methods developed in this laboratory to eliminate some of the difficulties encountered in the handling of these monkeys:

The large cages were remodeled in such a way (Fig. 1) that a large, rectangular, plywood "sweep" (1) with hand holes cut in one end can be inserted into a space above the door, and an opening fitted with a sliding door (2) was cut in the lower center of the cage door. This opening is so fitted that a small transfer or exposure cage (Fig. 2), measuring 14 x 14 x 24 inches and fitted with a sliding door (3) which corresponds in width with the slide door on the large cage, can be hung over it by means of strap hooks (4). To transfer the monkeys, both slides are raised and the sweep inserted along the top of the large cage, brought down along the back, and slowly drawn forward. The monkey is forced along in front of the sweep into the small cage. When two monkeys are occupying the large cage, it is not difficult to insert the sweep between them in order to remove one. The sweep is also useful in confining the animals to the upper rear section of the cage when it is necessary to open the slide door or remove the floor screen and the debris pan for cleaning.

For securing the monkeys for the purpose of drawing blood, a separate "elevator" cage (Fig. 3) was designed. This is approximately the same size as the transfer cage and, like it, contains a slide door and hooks for attachment to the large cage. The elevator cage, made with a 2-inch opening extending across the top of each side panel, contains a plywood false bottom (5), or elevator, which can be raised and lowered by means of ¼-inch pipe (6) attached to its diagonally opposite corners. The pipe passes through 4-inch nipples (7) of ½-inch pipe, which are attached to the reinforced corners of the top of the cage. The top of these nipples are cut off at an angle and the remaining lip bent back to an angle of approximately 40° to provide a fulcrum point for the outer edge of a large steel washer (8). The top of the ¼-inch pipe is provided with T's and short nipples to act as handles. When the elevator is raised, the washers slide freely on the pipe; when the upward motion is stopped, they cock at an angle and secure the pipe at that point. By lifting the low side of the washers the pipe is released and the elevator can be lowered. After the monkey is transferred to the elevator cage, the elevator is raised until the animal is held securely against the screen at the top. In this position a limb of the animal can be drawn out through the most convenient opening on the side and the necessary work performed with a minimum of disturbance from the animal.

FIG. 2

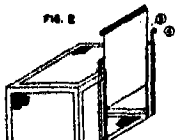


FIG. 1

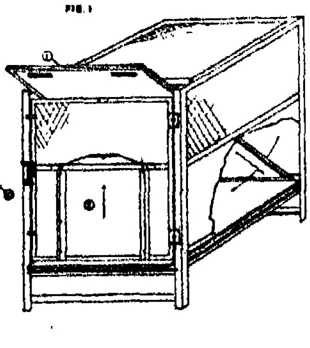


FIG. 4

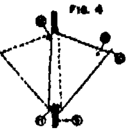
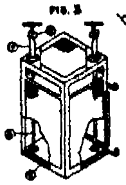


FIG. 3



To facilitate the use of the "sweep" in the large cage, feeding and watering bins or troughs that can be swung in and out of the cage from the outside were designed. Fig. 4 is an end view of the bin in a cross section of the cage wall (9). The V-shaped bins, 5 inches wide at the top, 4 inches deep, and 10 inches long, are made of galvanized sheet iron and the bottom rounded on a radius of ⅜-inch. The end pieces are attached about ⅜-inch from the top edge of the bin to allow a lip or extension (10) along the top of the sides. The lower parts of the end pieces extend approximately 1 inch below the rounded bottom. An inverted V cut (11) is made into this extension, the apex of the V extending to the bottom of the bin. A rectangular opening is cut at a convenient level in the lower side or rear panel of the large cage to accommodate the bin. This opening is 10 inches long and of a height equal to the distance from the apex of the inverted V to the outer edge of the bin, not including the lip or side extension. Small slide bolts (12) are mounted horizontally on each side of the opening of the cage, approximately ¼-inch from the top. The bin is placed in the cage opening by inserting the lip and allowing the inverted V cut to rest on the bottom of the opening. It can then be swung either in or out until it is stopped by the extension lip on either side of the bin. To secure the bin in the "in" position, the bolts are slid over the outside of the bin; in the "out" position, they are slid into holes (13) drilled into the ends of the bin. When the bin is removed for cleaning, a metal plate slightly larger than the opening and having small tabs bent in on the bottom edge can be inserted to prevent escape of the animals.

Acid Phosphatase and Lipids in the Mast Cells of the Rat[1]

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The presence of alkaline phosphatase and cytochrome oxidase, localized in the form of cytoplasmic granules in the mast cells, has already been reported (*4, 5*). Acid phosphatase has been stated to occur only in negligible amounts in the mast cells (*4*). With a slight modification of the technique of Gomori and of Wolf, Kabat, and Newman (*2*), we have been able to demonstrate that acid phosphatase, like alkaline phosphatase, is abundant in the mast cells. This enzyme is localized in the mast cells as discrete, coarse, cytoplasmic granules, brown to black in color. This localization in granules, in contrast to the diffuse appearance of the enzyme in other tissues (*3*), suggests that possibly these granules which contain acid phosphatase correspond to the mast granules. No phosphatase activity was found in the nucleus.

To demonstrate acid phosphatase activity in tissues embedded in paraffin it is necessary to incubate them in the buffered substrate for comparatively long periods of time. For this reason it is thought that the method is faulty, and that perhaps the enzyme is partially denatured during infiltration in paraffin at high temperatures. For the demonstration of acid phosphatase, tissues are fixed in chilled acetone for 12 hours or longer, cleared in toluol or chloroform, infiltrated in paraffin, sectioned, and mounted in the usual manner. The deparaffinized sections are then incubated at 37° C. in a solution of sodium β-glycerophosphate buffered (acetate) to pH 4.7. In these sections enzyme activity in the mast cells is shown after long periods of incubation and is never clear before 24 hours. Often the section must be incubated 72 hours or longer. Better results are obtained when the paraffin infiltration method is eliminated. Whole mesenteries are spread on pieces of cork (previously immersed in cold acetone) and fixed in chilled acetone overnight. The acetone is removed in several quick rinses of distilled water, and the mesenteries incubated in the buffered substrate at 37° C. Some acid phosphatase activity is noted within 1 hour in granular foci in the mast cells. Maximal enzyme activity is obtained in 4–6 hours. Longer incubation periods are undesirable, because after 24 hours the mast cells become so dark that details are obscured. It seems advisable, then, to eliminate the paraffin method from this technique whenever possible. Perhaps embedding in collodion would be satisfactory, since it does not require infiltration at high temperatures.

Our previous findings do not reveal lipids stainable with Sudan IV in the mast cells of the rat. Although Sudan IV gives consistently negative results in the mast cells, when Sudan black B is applied to frozen sections of tissues fixed in formal calcium-cadmium (*1*), black granules are revealed in the cytoplasm of the mast cells. These lipid granules resist dissolving with solvents and appear to represent phospholipids. Lipid granules have been demonstrated previously in human mast cells (*5*) by the use of Sudan black.

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[1] This investigation was supported partially by a grant from the Gans Fund, Bethany College, Bethany, West Virginia.

Sulfur Collection in Precipitation by Means of an All-Weather Noncorrosive Rain and Snow Gauge[1]

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Sulfur, an essential element for the growth of plants and animals, is known to be present in three amino acids (cystine, methionine, and djenkolic acid), the tripeptide glutathione, and two vitamins (thiamine and biotin). Increasing attention is being given to the content in foods of the sulfur-containing amino acids (*2*) as factors in food quality. The total sulfur in plants (and possibly the total of these essential sulfur compounds) is increased by increasing the supply of available sulfur in soils (*4*).

In the course of ordinary fertilizer practice, available sulfur has been supplied to the soil in the form of ammonium sulfate, potassium sulfate, and superphosphate. However, with the anticipated increased use of higher-analysis fertilizers these sources of sulfur will be decreased. Thereafter, except for a small reserve in the soil, the chief natural source to growing plants will be that brought down in the precipitation.

With regard to soil reserves, Lipman and Conybeare (*3*) have reported that, on the average, the soils in the United States contain only about 700 pounds of total sulfur/acre. This is for the most part insoluble and unavailable at any one time; also, that becoming available is subject to rapid loss by leaching. Thus, the quantity of sulfur brought down by precipitation will become increasingly important.

In order to measure the sulfur brought to the soil in rain and snow, a special rain gauge has been designed at this Station. The two general requirements to be met in making this gauge accurate and workable for the purpose were: (1) prevention of absorption of sulfur in gaseous form from the air, and (2) effective functioning in both winter and summer.

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[1] Journal Paper No. 294, Purdue University Agricultural Experiment Station. Contribution from the Department of Agronomy. Project supported in part by funds of the Texas Gulf Sulfur Company.

Alway (*1*) has shown that certain metals, when used as the collecting vessel, might absorb considerable sulfide from gaseous form in the atmosphere. Of the common construction metals, aluminum is the only one which does not form an insoluble sulfide in air, and this metal was therefore selected as the basic material for the gauge.

The second requirement entailed the collection of a representative catch of rain and snow in winter, at the same time avoiding damage to the apparatus due to freezing. This problem was met by constructing a well-insulated gauge, with storage container below frost line. A cross-sectional sketch is shown in Fig. 1. Once the gauge is installed, the water is collected in an ordinary 1-gallon jug placed inside an insulated waterproof cylinder (well), which is sunk below the frost line. The dismantled unit is shown in Fig. 2.

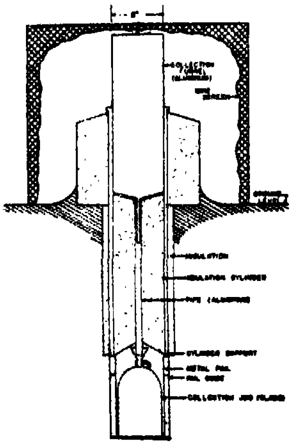

Fig. 1

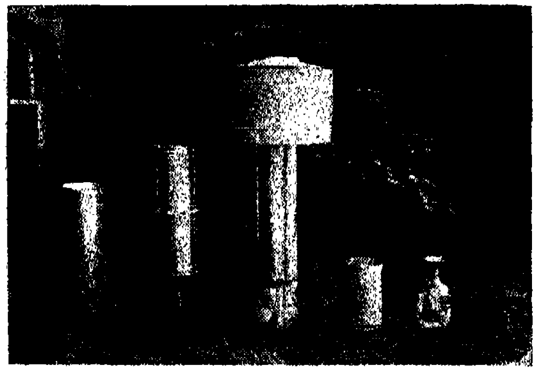

Fig. 2

Insulation (Fig. 1) to make the well arrangement an effective protection against freezing involved: (a) an insulation cylinder of glass wool, 28 inches long, separating the collection funnel from the gallon jug. A 1-inch aluminum pipe extends through the insulation cylinder from the collecting funnel to the small funnel in the jug; (b) a cylinder of 5 inches of glass wool around the exterior of the above-ground portion of the well; (c) a cylinder of 1 inch of glass wool around the below-ground portion of the well; and (d) a coat of lamp black on the exterior of the above-ground parts to absorb all possible heat from the sun in the winter. At the 3-foot level in the ground (depth of the middle of the jug), although the temperature varied between 26° and 41°F. at Lafayette, Indiana, during the period February 11–20, 1947, neither the gauge nor the contents were damaged. This suggests the advisability of thicker insulation and deeper placement in colder regions.

The gauge is relatively easy to manipulate, since only three units need to be handled in order to reach the collected water (solution). After the collecting funnel is removed, the insulation cylinder is drawn out, and finally, an iron rod is used to hook the pail containing the collection jug. The pail is used as a precautionary measure, a safety factor if the jug breaks. The gallon jug is large enough to hold 5.4 inches of rain, which is more than the average monthly rainfall in this area. In the event of heavy rains it is changed as often as may be required.

Farmer cooperators who operate the gauge regularly send the jug containing the solution to the Station for analysis. When snow collects in the funnel and is not melted by the heat of the sun or increase in air temperature, the farmer operator removes the funnel and the collecting bottle to the house, covers the funnel, sets it on a suitable stand, and the snow is melted into the jug. The collecting funnel stem fits into the smaller funnel, thus preventing any loss during melting.

In choosing the site for the gauge, it was considered important to take cognizance of the variable sulfur content of the air as affected by external conditions. Volk, Tidmore, and Meadows (*4*) reported a variation of from 7.23 pounds SO_3/acre annually at Kinston, Alabama, a rural area, to 76.79 pounds SO_3/acre near Birmingham, Alabama, an industrial area. Thus, sulfur deficiency would be expected in the former area but not in the latter. Four major factors were considered in choosing a site: (1) proximity to an industrial area; (2) proximity to a railroad; (3) direction of prevailing winds in relation to the sources of smoke; and (4) careful selection of site in order to catch a good sample of the rainfall representative of the conditions selected, considering the three foregoing factors. Ideally, the gauge should be placed in a clearing within a forested area (especially for snow collection). Since this requirement could seldom be met, it was concluded that meeting the following requirements would insure relatively representative sampling. The first three items are those set forth by O. E. Hays, of the Soil Conservation Service, in a communication to one of us (M. L. J.) in October 1944.

(1) The site should be nearly level and protected from grazing stock.

(2) Any area which suggests localized differential wind conditions should be avoided.

(3) Exposure from the sky must not be obscured; as a working rule the gauge is set at least twice as far from any obstructing object as the obstructing object is high.

(4) As suggested in 1945 by N. J. Volk, a wire screen, placed around, and slightly higher than the gauge (Fig. 1), will prevent contamination by bird perching, since birds tend to light on the screen in preference to the gauge. The screen will also serve as a windbreak.

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Book Reviews

Encyclopedia of endocrinology. Section IV: ***The ovary***; Vol. VII: ***Ovarian tumors.*** Hans Selye. Montreal: Richardson, Bond and Wright, 1946. Pp. vi + 289; Bibliography: Pp. 427. $21.75.

In this two-part volume, which forms Section IV of a contemplated 10-section treatise, Dr. Selye has undertaken an experiment designed to demonstrate the practicability of preparing, as he expresses it, a rational classification and evaluation of all publications pertinent to a large field of medicine. In this instance consideration is given to ovarian tumors as part of the field of endocrinology.

In his interesting foreword the author reveals the realistic and generally unexpressed suspicion that some of the very heavily financed investigative efforts now in progress are, in many instances, of the leaf-raking variety, probably more productive of voluminous reports by job-maintaining, time-killing researchers than they are indicative of that critical and spontaneously sustained avid scientific interest possessed by so few.

The text is divided into 10 sections, each marked by a marginal thumb index. The general plan for each section, or chapter, is similar. The author first gives literary references to general reviews, in the various languages, covering the subject matter. These are followed by a definition of material under consideration, a brief history of the subject, a classification, a discussion of the pathologic anatomy, chemical considerations where indicated, incidence, pathogenesis, clinical course, complications, diagnosis, prognosis, and therapy.

The last five subheadings arouse this reviewer's curiosity, for they are concerned primarily with clinical considerations, and the author, although a doctor of medicine, is not a clinician. It has therefore proved interesting to see how these subjects are treated by one whose efforts have been confined principally to the preclinical phases of medicine. It is apparent that the author's lack of experience in the clinical arena at times deprives the text of a much-needed critical clinical evaluation.

The first chapter is devoted to a general discussion of ovarian tumors. Obviously, the author's first task is to define what he means by an ovarian tumor. This, it must be conceded, he has not done. He states (p. 2) that the transplantation theory of endometriosis is now generally accepted. It is doubtful, however, whether this general acceptance exists. Ten different classifications of ovarian tumors, including one of the author's are given. Dr. Selye's own classification does nothing to assuage the general unsatisfactory prolixity that clouds the subject.

It is stated (pp. 2 and 3) that folliculomas and Brenner tumors have been known to cause virilization. The reviewer finds it difficult to accept such a flat, unqualified statement in a field where the utmost reserve is essential.

The author states (p. 15) that ovarian neoplasms, such as folliculomas, and particularly follicle cysts, which secrete an excess of folliculoid material may, therefore, be oncogenic and produce primary tumor formation in another organ. This statement has an uncomparable experimental basis and not more than questionable clinical support.

The discussion of the use of ovarian tissue for biopsy in the course of an operation as a guide to conservative or radical surgery (p. 23) would be more helpful to the general reader if it were distinctly emphasized that where the tumor is single and can be completely delivered and removed, material for biopsy should be obtained after such removal. This would avoid spilling material from an unsuspected cancer cyst or a mucinoid tumor into the peritoneal cavity. Under differential diagnosis the author fails to mention corpus luteum persistans and the occasional large, simple, follicular cyst, which produce clinical tumors whose character can only be suspected and which, under observation, generally disappear permanently.

Para-ovarian tumors are interestingly and well discussed in the second chapter.

Endocrine tumors comprise the next section. Follicle cysts are first discussed. The author apparently believes that so-called cystic ovaries that may occur after hysterectomy, salpingectomy, etc., are invariably due to disturbances in formation of the gonadotropic hormone. The fact that interference with the ovarian circulation may be the principal factor in most instances, due largely to the surgical technic employed is not considered.

In discussing "metropathia hemorrhagica" (p. 39), Dr. Selye considers inclusion of abnormal uterine bleeding appropriate because this is the most important clinical manifestation of cystic ovaries, while the principal associated uterine endometrial change is a benign glandular hyperplasia. The issue is patently confused by considering that endometrial hyperplasia is always present and therefore synonymous with metropathia hemorrhagica. Certainly in the reviewer's experience, critical study of abnormal uterine bleeding of the so-called dysfunctional type is by no means generally associated with endometrial hyperplasia. More often the picture is that of a proliferative, nonsecretory endometrium. Occasionally an unmistakable premenstrual secretory change is observed. It is regrettable that a problem which has begun to show some clarification in modern texts is again rendered confusing and misleading to the reader.

Under differential diagnosis of metropathia hemorrhagica (p. 43) the highly debatable statement is made that this abnormal bleeding state is not likely to be confused with cervical cancer, because cervical cancers *are palpable and visible at an early stage of their development* (italics the reviewer's).

The author states unqualifiedly (p. 51) that the folliculoma (generic term for granulosa cell tumor) is a tumor of the ovarian follicle. To the tyro this will prove a misleading statement and one which, because of its simplicity, he unfortunately is likely to remember.

The section on corpus luteum cyst leaves much to be desired. One may well question whether Fig. 3, plate 11, is a corpus luteum cyst, as designated, rather than a normal large cystic corpus luteum. A good discussion of lipid cell tumors follows. The author also discourses interestingly on so-called testoid hyperthecosis. However, when he states that ovariectomy must be the treatment for this ill-defined state (p. 74), one may well question the wisdom of his recommendation.

Under tubular adenomas there is a good discussion of the tumors commonly referred to as arrhenoblastomas. Also included are the small, not uncommon, so-called rete adenomas. The author's logically presented reasons for the term tubular adenomas fail, however, when he includes those tumors which show no identifiable tubular elements but are associated with virilizing phenomena.

The heading "Ovarian Common Cysts," as used (p. 98), is confusing, because the discussion actually concerns cystic neoplasms, *i.e.* cystomas.

The sections on endometriosis and teratoid tumors are excellent. It would have been helpful, however, if the author, in discussing dermoid cysts, had more fully evaluated the relative importance or unimportance of X-ray studies in their diagnosis (p. 235). It is also confusing to note so many illustrations labeled as "dysembryoma," since the term is hardly utilized in the body of the text.

The final section is given over to nonepithelial ovarian tumors.

The illustrations throughout the text vary from indifferent to excellent. A 60-page list of periodicals which concludes this volume might well be included in the bibliographic volume in future editions.

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Musical acoustics. (2nd ed.) Charles A. Culver. Philadelphia: Blakiston, 1947. Pp xiv + 215. (Illustrated.) $3.00.

At the recent meetings of the Acoustical Society in New York physicists and engineers mapped grand strategy for a peaceful invasion of the field of music. Prof. Culver's book constitutes somewhat of an insurance policy to future generations of musicians that the invasion will remain a peaceful one; or, if this invasion should prove less peaceful than advertised, it guarantees to those musicians who will study it that they will at least be able to understand the language in which the peace treaty may be written.

Musical acoustics is a useful and readable book for those interested in the physics of music. It should also bring reading enjoyment to a much wider audience. It should prove most valuable, however, as a text in a one-semester course for music majors. The book is written at a level appropriate to the usual background and needs of such students.

An introduction to certain general principles of acoustics is followed by chapters on hearing, pitch, and quality. From there we go to a discussion of somewhat more technical topics such as musical intervals, temperament, consonance, and dissonance. The author never tries to draw up a musical code or to arrive at aesthetic judgments on the basis of cabalistic juggleries; on the contrary, he invites the reader "to maintain an open mind with regard to the possible adoption of new forms of tonal expression."

The second half of the book is given over largely to a comprehensive treatment of the production of musical sounds by the more important instruments. Here we find a wealth of oscillograms and sound spectrograms, many of which have been taken by the author himself. Prof. Culver's own contributions to experimentation in this field—the harmonic analyzer for unsteady musical sounds and the Synthephone, which produces entirely new musical sounds—find their natural place in these surroundings. In the last part we find a chapter on "The Acoustics of Rooms," followed by a rather brief chapter on "Electronic Musical Instruments."

In this second edition Prof. Culver concludes with a discussion on the recording and reproduction of music. Beyond this substantial addition there are entirely new sections on the Doppler effect and transients and an enlargement of the section on vocal organs and the voice.

In the spirit of constructive criticism, which Prof. Culver invites, this reviewer would like to make two minor points. It should be possible to replace many of the oscillograms by more distinct ones. Some progress in this direction has been made in this edition, but there is room for more, Also, nowhere in the book do we find a discussion of auditory masking, though its importance for composers and orchestrators can hardly be overlooked.

All in all, Prof. Culver's book points the way toward a more sympathetic cooperation between the scientist and the musician in their very pleasant task of making man's life richer and more beautiful.

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Russian-English technical and chemical dictionary. Ludmilla Ignatiev Callaham. New York: John Wiley, 1947. Pp. xvii + 794. $10.00.

It is to be regretted that this dictionary was not made available some five or six years ago, when the need for such a book was very urgent. It is more than a chemical dictionary, for it includes a fairly complete coverage of mineralogy, metallurgy, mining and geology, general engineering, machinery and mechanics, electrical engineering, pharmacy, and botany, as well as other pure and applied sciences.

The book is generally well done and contains less than the expected number of deficiencies for a first edition. A number of possible meanings provided for each Russian word may be considered as adequate. The lesser deficiencies may be typified by the translation of "АЛОСТЪ," which is really a state of redness rather than "ruby color." The translations of a number of compounds in the phosphorus family do not conform to the accepted nomenclature and may be misleading; thus, "фѲСфИНИСТАЯ К." should be -phosphonous acid, and "фОСфИНОВАЯ К." should be -phosphonic acid. The reviewer feels that the inclusion of the letters of the old orthography should have been permitted because of the existence of a considerable amount of pre-Soviet literature. This is compensated for, however, by a number of highly desirable features: translations of numerous abbreviations, a listing of word endings, and a good coverage of idiomatic phrases.

Although the appearance and legibility of the book are very good, one would expect a more durable binding for a book of this size (and price) than the "flexible" one provided. A thumb index should also have been provided to facilitate the use of the book by persons not fluently familiar with the Russian alphabet.

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Science and the Public

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THE EXISTING RELATIONS BETWEEN science and the public can still be summed up largely in the anecdote used by Lord Rayleigh at a similar occasion a decade ago. The great Australian transcontinental railway had been completed, and the first train was being dispatched at a gala ceremony. At the climactic moment, the passengers waved, the crowed cheered, the signal was given, and the locomotive proudly started off—leaving the train standing. Someone had forgotten to couple the engine to the cars.

True, in the interval the public has become far more aware of science and scientists of the public, thanks largely to the drama—or should I say tragedy?—of the atom bomb. But this awareness, on the public side, is in some ways even worse than indifference, for the people think of science more and more as a sort of black magic, threatening their traditions continually and likely to blow them up momentarily. Even at best, science to them is the creator of comfort-improving gadgets or of miracle drugs, never an objective attitude and a rational attack on problems. Yet it is the attitude and method of science which can save society, even more surely than some products of science can destroy it.

It is also true that in the past decade many scientists have accepted and struggled to perform their obligations to the greater community of which scientists are part. The American Association of Scientific Workers, the American Federation of Scientists, and particularly the Federation of Atomic Scientists—all groups concerned broadly with such ends—and increasingly the AAAS, have achieved some real results, and individual scientists have given unreservedly of their effort and influence. But, by and large, the scientists and technologists remain somnolently unaware of the world beyond their equations, spectrometers, microscopes, or oscillographs. A year ago, the grouped chemical societies of Chicago, in cooperation with the AAAS, arranged a first-rate symposium on the relations of government to science. A few handfuls of chemists came to listen. In November 1946, the Chicago Technical Societies Council, representing scientific engineering and technological societies with a membership of 21,000, staged a comparable panel on UNESCO and science, and only 200 of the tickets were taken by its members. Dr. Compton's story of his sister in India is still apposite. Annoyed with the endless requests of the native electrician for instructions, she burst out, "Why don't you use your common sense?" "Madam," he replied with grave courtesy, "Common sense is a rare gift of God. I have only a technical education."

The means to improvement are different in the two cases. Scientists need a broader educational base before ascending their towers of specialization, a base including not only some acquaintance with the wider problems of society but even a more vivid indoctrination with their own scientific method. This, however, leads into problems of higher education for the few, whereas this symposium is directed primarily to the problems of basic education for the many, and so to the other pole of the relationship.

The engine of science is running, but if it does not pull the public passengers with it, it will not long be stoked. The coupling must be closed by means of the media of mass communication. The technological devices for this are now abundantly available; their use and abuse will be the subject of the following speakers. I can be most useful, perhaps, in specifying further the present and the desirable relation between science and public.

First, what is the public entitled to, and what is it not entitled to, in the way of science news? It is not entitled to sensational, uncritical, and often partisan reports on results or conclusions which have not yet run the normal gamut of scientific testing. The validity of research findings should not be argued before the public as jury. The mass audience of magazine or newspaper, movie or radio, does not have, and cannot possibly have, the knowledge which entitles it to make a judgment—nor do the writers or producers, except in rare cases where they have themselves had extensive experience as active scientists. Only the collective and slowly accruing labors of the actual workers in a field can render a useful decision. (I do not say a true decision, for obvious reasons. "Useful" means that it leads to further theoretical understanding or to successful practical application.) This decision may be essentially unanimous, as when penicillin burst forth as a successful antibiotic, or may for a period involve two or several opposed positions, as in the running battle over the nature of cosmic rays. Of course, as evidence mounts, such disagreements resolve and a unanimous position is reached.

From the opening lecture presented at a round-table discussion on "Science and the Public," AAAS meeting, Boston, December 28, 1946.

Author's note: Names of specific writers, magazines, and newspapers, as well as a discussion of details of the Kenny publicity, have been deleted by the editors for publication.

Presumably the public is entitled to know of penicillin as soon as laboratory and clinical trials have convinced those working with it, as a group, that it has the virtues anticipated. Early publication may still cause great anguish to investigators flooded by appeals for unavailable material and to relatives believing their loved one is dying in the presence of succor, but it may also arouse great action and accelerate use and speed advance. Publicity is essential in health campaigns against tuberculosis, cancer, and the like. The public is also entitled to know, if interested, of the ray-particle debate about cosmic energy reaching our planet. This, at the lowest level, gives something to gape about; at a higher level—that is, with the arguments and evidence for each view presented—it can be highly educational and stimulating. At neither level, however, can the public do anything about it or become personally involved.

The case is quite different when the public *is* involved not merely as spectator or student but as actor or judge. When a popular monthly magazine published a glowing account of a foolproof treatment of ringworm, by a mixture of 50 per cent camphor and 50 per cent carbolic acid, it created an epidemic of severe skin burns and performed a disservice to everyone except possibly some financially low dermatologists. On what evidence were such claims publicized? Had the magazine or the author the scientific or moral right to decide that the claims of a particular experimenter were sound?

More recently, a well-known science writer on a metropolitan daily newspaper burst forth with starry-eyed accounts of Bogomolets' antiage, anticancer, antireticular serum. His stories were the first word I had of the ACS work, and, I must confess, though reasonably familiar with the area of knowledge involved, I was quite unable to tell from them what had actually been done or even what was the reasoning behind the work. This was unfortunate, since this particular writer had quoted categorically a sentence from my book, *Unresting cells*, published several years earlier, in which I summed up some biological evidence that the human life span might be as long as 150 years; and this mention flooded me with hundreds of letters begging for information or, mostly, for treatment.

Shortly thereafter I had an opportunity to talk at length with the associate director of Bogomolets' Institute and with the secretary general of the Soviet Academy of Medicine, both of whom assured me that there had been no significant trials of ACS on longevity or cancer, in man or animals, and that the public furor stirred up in this country (far more than in Russia) had done real damage. There was only some evidence that ACS accelerates the healing of bone fractures and chronic ulcers.

As a final example on this point I merely mention the publicity accorded Sister Kenny and her treatment for infantile paralysis. The most effective treatment of poliomyelitis will be determined by no popular vote or movie producer but by continued scientific investigation and clinical experience. Science, medicine, and the public alike suffer when any other approach is attempted. On the other hand, when answers have become clear, such motion pictures as those presenting the lives of the Curies, Ehrlich, and Pasteur offer invaluable vehicles for education of the public.

If we think of science as an exciting sport, as indeed it is, then the final score of each game is certainly for the public. So also is the inning-by-inning progress, provided it is clearly recognized by all as just a progress report and provided the reporter has some official or semiofficial authority for his statements. Still better, if the public is taught some of the rules of the game, it can follow with excitement a play-by-play account. It must never be placed in the role of umpire. Also, it must learn to respect the expertness of the players. This last is a most critical point.

The egalitarian philosophy of America proclaims that all men are created equal, and, as the Irishman said, "One man is as good as another, or maybe a little bit better." In discarding the tradition of an aristocracy by birth we have thrown out the very notion of quality. Now, plainly, some men *are* far better than others, for given functions, by hereditary endowment or acquired experience, and the public recognizes this well enough where it is familiar with the situation. It knows that a special combination of endowment and training is needed to make a Joe Louis, a Babe Ruth, or even a Paderewski, and it would rightly scoff at a professor of sociology who pontificated about pugilism. But the reverse is not true. The public does not know sufficient about scientific evidence and procedure to recognize as ludicrous the anthropological antics of Bilbo, the biological blather of Irene Castle ex-McLaughlin, or the chemical confusion of most literary atom bombardiers. The public does not know its scientific A.B.C.'s—and it doesn't know that it doesn't know! Even at the height of scientist prestige, in a technological war, America alone drafted its science students. We cannot expect the layman to surmount his ignorance in technical matters, but we can expect him to recognize it. We must teach him the weight and value of a scientist's opinion where scientific evidence is involved. A democracy that does not respect expertness in the intellectual area, as it does in the sports arena, is bound for extinction in an age of technology!

Scientists, I have argued elsewhere, are the sense organs of the social organism which worry it forward along the path of evolution. They probe the environment and must help guide the response of the society. It is their responsibility to obtain valid information about the world and to help in its assimilation and application. The educators, whether of children or of the mass of adults, like the nervous system, must communicate such information, *in its proper relations*, to the whole of the body politic. The public must nourish and protect and value its scientists and educators as the body biologic does its eyes and brain. Science must be supported financially and learning prized socially far more than they are if our society is to remain healthy.

Perhaps some of the serious dislocations originate just in the fact that education and research are, for the most part, dependent on public sources for their scant support, while communication is well nourished by the profits of business enterprise. What the enlightened editor of the Sunday magazine section of a great newspaper chain told me recently is illustrative. He said that the Sunday supplement was reforming, in that features would be truly educational rather than rankly sensational. He had convinced the publisher that this approach would actually increase circulation. "But if circulation falls?" I asked. "Well, of course, we must sell papers to make a profit."

Let me sum up. For a healthy democracy the following circular relations should hold: The public should be kept informed of the authoritative advances of science and, even more, should be instructed in the manner in which science achieves them. The public must be made aware of the dignity of expertness and the compulsion of facts. Only so can the state, and all states, act rationally in this era of great sociological interdependence and tremendous physical power. Only so will science receive the financial support and dignified position it must have for the good of the whole. The scientist must recognize his role as "mover and shaker of the world," must qualify himself to shoulder his consequent responsibilities, and must in reality shoulder them. Only so will science flourish and serve. Those who work with the mass media of communication must insist on ever better standards of reliability and significance in what they communicate—standards which guarantee the discharge of a public duty as well as accumulation of a private gain. Only so will they be allowed long to continue as private enterprises. Only so can the public learn what it must know to function as a democracy.

These objectives might be achieved in many ways: by certification of newsmen; by featuring science rather than treating it as spot news; by training in scientific journalism; by liberal education of scientists; by greater public service from scientific societies, such as sponsorship of syndicated science columns or publication of science magazines (the new one, *The Sciences*, should concern the AAAS); by approval or, more dangerous, condemnation by official scientific bodies, such as the AAAS, of public reports on scientific matters; by boards of scientific consultants for newspapers, radio, etc.; by government support of research and subsidy of mass media; by government agencies of communication, such as the OIC of our State Department; and by, potentially best of all, the operation of UNESCO.

There is much to say on the changing situation up to now—on the greatly improved performance and standards of science writers, fostered by their national association, who are now often as much frustrated as were the scientists earlier by the way in which the editorial desks handle their copy; on the growing interest of the public in science and of scientists in the public; on the shift of need from the mere reporting of science to the *good* reporting of science. But these are matters for careful discussion. What may be re-emphasized now is that science, communication media, and the public are inextricably bound to each other. They must not merely interact, but they must interact usefully. They are part of a whole society. For purely selfish reasons, each must minister to the needs of the others, for only so can it survive.

Use of Civilian Skills in the Army Air Forces

Thomas W. Harrell
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THE UTILIZATION OF CIVILIAN SKILLS in the armed forces, whereby a man works at a military job similar to his civilian job, has been recognized by military personnel administrators as sound policy as a general rule, although subject to some exceptions. On the other hand, some civilian critics have been so impressed by the number of exceptions as to doubt that military procedure followed the policy.

No related published study dealing with American personnel can be cited, but there is a related English study, embodied in *Second report and a memorandum by the War Office*, published by the Committee on Skilled Men in the Services (February 1942). In that study one group of 348 men from civilian engineering and allied occupations was followed up in the military service. Of this group, 44 per cent were not serving in related military jobs, nor did they have responsible assignments. The study included Navy, Air Force, and Army personnel.

Recently it has been possible to complete a study of the utilization of civilian background by the U. S. Army Air Forces.[1] Rosters, prepared by each organization of the Army Air Forces Air Service Command located in the United States, showed, among other things, the Main Civilian Occupation and the Military Occupational Specialty for each enlisted man. The function of the Air Service Command, as its name implies, was to give service and not to fight. This service included maintenance and repair of airplanes, building landing fields, maintenance of supply records, looking after motor pools, and running hospitals. Since fighting was not a part of the activity of the Air Service Command, gunners or other purely fighting men were not numbered among its personnel. Such a restriction to nonfighting men has an advantage for the present study in that it eliminates the question of whether the use of a man in a purely military capacity is an acceptable use of civilian skill.

Nine occupations which are performed in the AAF and which are similar to civilian occupations of the same name were chosen for study: (1) cook-baker, (2) truck driver, (3) sheet metal worker, (4) machinist, (5) welder, (6) auto mechanic, (7) clerk-typist, (8) tabulating machine operator, and (9) carpenter. The choice of these occupations was also based on the fact that they were frequently performed in the AAF and that the AAF obtained considerable numbers of men with parallel civilian occupations.

A tabulation was made of the records of 100 white men whose Main Civilian Occupation was that of cook-baker, 100 white men whose Main Civilian Occupation was truck driver, and so on for each of the occupations mentioned. No records were included of men who had had more than three years of military service, since it was thought that only men brought in under Selective Service were comparable (The rosters were compiled in the fall of 1943.) In general, records were not included of men who had less than six months military service, since it was considered that a man's military classification might be more accurate after such a minimum time. (Several exceptions were made to this six-month rule in order to complete 100 cases for a few of the occupations.)

For each man whose record was selected for tabulation, his Military Occupational Specialty was tabulated together with his Army General Classification Test score.[2]

Similar tabulations were made of the records for 100 white men whose Military Occupational Specialty was cook-baker, 100 white men whose Military Occupational Specialty was truck driver, and so on for each of the 9 occupations. Again, the maximum military service was three years and the minimum in most instances was six months, for the reasons stated above.

A civilian auto mechanic might not be assigned in the AAF as an auto mechanic but might be making considerable use of his civilian skill by being assigned, for example, as a Diesel mechanic. Or the civilian auto mechanic might be making some use of his civilian skill in an assignment such as airplane armorer. As a matter of fact, Army Regulations provide such classifications in terms of (1) military assignments most highly recommended for a particular civilian occupation, and (2) military assignments having some relations to a civilian occupation.[3] Consequently, the Military Occupational Specialties of the 100 former civilian auto mechanics were classified as to whether they were (1) closely related, (2) moderately related, or (3) unrelated. Army Regulations were used in this classification, but since the regulations were not complete (they were not intended to be), they were supplemented on the basis of

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[1] A grant from the Graduate Research Board, University of Illinois, made it possible to tabulate the data presented herein.

[2] Information about average and range of AGCT scores for military occupations is given in an article by the writer (*Educ. psychol. Measurement*, 1946, *6*, 341-349).

[3] Army Regulations No. 615-26, 1942. There are later pertinent regulations, but those cited are most convenient for the present data, since the rosters were based on classifications of Military Occupational Specialties defined at that time.

judgment. This judgment was made by following a policy of classifying an occupation as closely related if there was a possibility of its being so and classifying an occupation as moderately related if there was any possibility of its being at all related. The 9 civilian occupations were similarly classified as to the closeness of relation.

The results of the 1,800 tabulations are shown in Table 1. Tabulating machine operator is the Civilian Occupation which was directly used most often in the AAF. Of 100 men who in civilian life had been tabulating machine operators, only 2 were classified in entirely unrelated AAF Military Specialties, whereas 90 were in closely related specialties, leaving 8 in specialties moderately related to their civilian occupation. Clerk-typist has the next highest percentage of cases correctly classified from the standpoint of utilization of civilian skill. It may be of some importance that these two occupations standing highest in use of civilian skills are in the clerical-administrative group rather than in the maintenance group as are the majority of other Civilian Occupations studied. The fact that tabulating machine operators and clerk-typists were best classified cannot be ascribed to their skill level, since the time necessary for teaching those skills is no longer than that for machinists and sheet metal workers.

TABLE 1

RELATION BETWEEN CIVILIAN OCCUPATION AND MILITARY SPECIALTY

Civilian Occupation	Relation of Military Specialty		
	Close	Moderate	None
Tabulating machine operator	90	8	2
Clerk-typist	82	6	12
Machinist	40	34	26
Auto mechanic	29	45	26
Welder	43	24	33
Sheet metal worker	64	2	34
Cook-baker	52	7	41
Truck driver	15	13	72
Carpenter	14	14	72

Military Specialty	Relation of Civilian Occupation		
	Close	Moderate	None
Tabulating machine operator	79	14	7
Clerk-typist	44	18	38
Machinist	42	13	45
Auto mechanic	26	30	44
Welder	39	13	48
Sheet metal worker	27	21	52
Cook-baker	17	12	71
Truck driver	29	8	63
Carpenter	43	3	54

With samples of only 100 for each occupation, all differences are by no means thought to be significant. Ample military data is probably available for additional study of this problem if additional cases are desired.

The question of supply and demand is a natural one for a suggested explanation of the unevenness of skill utilization among Civilian Occupations. In other words, perhaps machinists and sheet metal workers were less often classified in the same jobs than were tabulating machine operators and clerk-typists because the supply of available specialists relative to demand was greater with respect to the two former occupations. Complete AAF data are not available, but the lower half of Table 1 suggests that supply and demand do not furnish the complete answer. If the fact that only 40 out of 100 civilian machinists were classified into closely related Military Specialties were due to supply and demand, it might be that the AAF possessed so many machinists that a large percentage had to be assigned on other jobs. The data, in so far as they go, clearly negate such an hypothesis, since it is found that only 42 out of 100 AAF machinists came from closely related civilian occupations. A similar comparison for the other occupations shows no basis for supply and demand as a major explanation of misclassification.

One question of method that may appear to be important to the results may be seized upon by anyone familiar with the details of the Army classification system. This is whether it would not have been more meaningful to use the actual AAF assignment rather than classification. There are reasons for preferring actual assignment and reasons for preferring classification in such a study. Actually, for the sample studied there was an agreement between classification and assignment which, on the basis of casual inspection, seemed to approximate 95 per cent. An advantage of using classification rather than assignment is that a man might have been doing a temporary job or, because of equipment shortage, might not have been performing the job for which he was classified.

One point frequently raised with respect to a direct comparison between civilian and military jobs is that a person with a supervisory job might be doing something of greater value to the service, even though his supervisory job was not closely related to his civilian job. This point is fairly well covered in the present study, since supervisory jobs that utilize a person's civilian skills in any way have been classified as either closely related or moderately related, depending on the nature of the case. For example, a civilian auto mechanic classified as a motor transportation NCO was tabulated as a case of "close" relation, and a civilian auto mechanic classified as a supply NCO, as a case of "moderate" relation. It is true that there are examples of noncommissioned officers whose classification bore no relationship to their civilian skills. Such cases, of course, would be found under the column headed "None," but they were extremely rare.

The top half of Table 1 shows that the median for the column headed "None" is 33. In other words, for these 9 occupations the AAF utilized the civilian skill of approximately two men in three—by a classification either closely related or moderately related to his civilian job. In the other one case out of three there was no relation between Civilian Occupation and Military Specialty. The range of nonuse of civilian backgrounds is striking. As shown in Table 1, it varies from 2 to 72 per cent.

Practically everyone who has worked with Army classification must be familiar with the fact that the rigidity of school quotas was one big cause of failure to use civilian skills thoroughly. One Reception Center or Replacement Training Center would be forced to fill within a short time its quota of men to be sent for training as military specialists. The housing facilities of the centers were not sufficiently great to hold men for a considerable period of time waiting for quotas more related to their civilian backgrounds. Undoubtedly such school quotas constituted an explanation of many of the failures to use civilian backgrounds that are reflected in Table 1. As a matter of fact, the rosters that were used show which school was attended in the Army. A preliminary tabulation of such data has been made.

Civilian tabulating machine operators were employed by the AAF in the highest percentage of cases among the occupations studied. Next in percentage of utilization are civilian clerk-typists. The former worked under administrative officers who were closely connected with those supervising the AAF Classification and Assignment Program. For clerk-typists, though they were assigned in almost every AAF organization, the situation was frequently similar. Statistics such as those in Table 1 cannot prove why one civilian skill would be neglected in only 2 per cent of the cases while another skill would be neglected in 72 per cent of the cases. These data do indicate that where, for some reason, sufficient pressures exist, civilian skills can be utilized almost perfectly.

The Cooperative Committee on the Teaching of Science and Mathematics:

Its Organization and Program

THE COOPERATIVE COMMITTEE ON Science Teaching was created in 1941 by representatives of several scientific societies to work on educational problems the solution of which can be attained better by cooperative action than by any single scientific group working alone.[1] Subsequently the Committee published a "Preliminary Report on the Preparation of High School Science Teachers," which has been used by a number of university and college faculty committees. Another problem attacked by the Committee—that of using high school science and mathematics to meet manpower needs during the war—resulted in a report on "High School Science and Mathematics in Relation to the Manpower Problem," which was published in 1943 and distributed to more than 12,000 individuals.

A further function of the Cooperative Committee has been to serve as a forum in which representatives of the scientific societies have been able to state the views of their own groups and to learn those of other groups on science teaching at the secondary and elementary levels.

The Committee has an advisory relation to its parent organizations and reports to them regularly through their representatives.

The Committee, as organized in 1941, consisted of the following representatives of scientific societies:

American Association of Physics Teachers: K. Lark-Horovitz, Purdue University, and Glen W. Warner, Wilson Junior College, Chicago.

Union of Biological Societies: Oscar Riddle, Department of Genetics, Carnegie Institution, and Walter F. Loehwing, State University of Iowa.

Mathematical Association of America: A. A. Bennett, Brown University, and Raleigh Schorling, University of Michigan.

American Chemical Society: B. S. Hopkins, University of Illinois, and Martin V. McGill, Lorain High School, Lorain, Ohio.

National Association for Research in Science Teaching: G. P. Cahoon, Ohio State University, and Robert J. Havighurst, University of Chicago.

The initial financial needs of this Committee were met by grants totaling $3,000 from the Carnegie Foundation for the Advancement of Teaching.

The original Committee served for three years without change of personnel and was then reorganized as a committee of the AAAS.

Invitations to associations to be represented on the Committee originate from the Executive Committee of the AAAS, each organization then submitting its choice to the Committee for confirmation and final appointment. In making selections, particular attention has been given to adequate representation of the teaching profession of secondary schools, colleges, and universities. The Committee selects its own chairman and secretary.

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[1] The Committee is indebted to President Emeritus E. C. Elliott, of Purdue University, who supported its early activities in every way.

As presently consituted, the Committee's chairman is K. Lark-Horovitz, Purdue University, and the secretary, R. W. Lefler, Purdue University. The following societies are represented:

American Association of Physics Teachers: K. Lark-Horovitz, Purdue University, and Glen W. Warner, Chicago City College.

American Astronomical Society: Oliver J. Lee, Northwestern University.

American Chemical Society: B. S. Hopkins, University of Illinois (recently resigned and to be replaced).

American Institute of Physics: Lloyd W. Taylor, Oberlin College.

American Society of Zoologists: L. V. Domm, University of Chicago.

Botanical Society of America: Glenn W. Blaydes, Ohio State University.

Central Association of Science and Mathematics Teachers: Arthur O. Baker, Cleveland Board of Education.

Division of Chemical Education, American Chemical Society: Laurence L. Quill, Michigan State College.

Executive Committee, AAAS: E. C. Stakman, University of Minnesota.

Geological Society of America: George A. Thiel, University of Minnesota.

Mathematical Association of America: Raleigh W. Schorling, University of Michigan.

National Association of Biology Teachers: Prevo L. Whitaker, Indiana University.

National Council of Teachers of Mathematics: E. H. C. Hildebrandt, Northwestern University.

National Science Teachers Association: Morris Meister, Bronx High School of Science.

The expenses of meetings, held at least twice a year, are now borne by the parent organizations, who pay the travel expenses of their respective representatives. Should the Committee engage in special projects requiring money for research or for publication, such funds are secured from interested sources. Thus, the parent organizations are not obligated beyond providing for the attendance of their own representatives at meetings.[2]

In order to preserve continuity of both interest and attendance, it is desirable that the parent organizations name their representatives for terms of several years, with different termination dates in cases of more than one member, and that they name representatives who are willing and able to attend all meetings of the Committee.

Committee Activities 1945–1947

Recently the Committee prepared and distributed a report on "The Preparation of High School Science and Mathematics Teachers," in which the following concrete proposals were made:

(1) A policy of certification in closely related subjects within the broad area of the sciences and mathematics should be established and put into practice.

(2) Approximately one-half of the prospective teacher's four-year college program should be devoted to courses in the sciences.

(3) Certificates to teach general science at the 7th-, 8th-, or 9th-grade level should be granted on the basis of not less than 42 semester hours of college courses in the subjects covered in general science.

(4) Colleges and certification authorities should work toward a five-year program for the preparation of high school teachers.

(5) Curriculum improvements in the small high school should go hand in hand with improvement in teacher preparation.

During the last year the Committee worked with the NSTA in the preparation of a report on American science education. The Scientific Apparatus Makers of America provided funds for the preparation of this report, which has now been submitted to UNESCO.

The Committee cooperated with the NSTA in a program on science education at the AAAS meeting in St. Louis, where it also sponsored a scientific exhibit. At the Boston meeting of the AAAS the Committee again participated in the NSTA program with a series of contributed papers and, in addition, arranged for a forum on "Problems of the Science Teacher."

At the present time the Committee is engaged in a study of the effectiveness of science teaching at all levels. A report of this study will be prepared for submission to the President's Scientific Research Board.

Future Plans of the Committee

(1) The problem of licensing or certification of secondary school science teachers, with its associated problem of combinations of subjects to be taught by the beginning teacher in the small high school, is generally recognized as a serious one. Most teachers begin their work in small high schools of 200 or fewer students. In such schools one person must teach three or four different subjects. Therefore, a college graduate with highly specialized training in a single science is at a disadvantage in securing a position or in his teaching if he is appointed. The Committee hopes to formulate recommendations regarding certification requirements with which all the scientific societies can agree and which suit the realities of the teaching situation.

(2) The Committee, recognizing the difficulty of preparing science teachers for such broad teaching assignments as are given to most new teachers, has been making a careful study of these problems and will release soon a proposal for a college program of study for the prospective teacher which will secure the necessary breadth of science

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[2] The Committee is indebted to President F. L. Hovde and Prof. C. W. Beese, director of the Division of Technical Extension, both of Purdue University, for making available the services of R. W. Lefler as secretary.

training, give reasonable opportunity for specializing in one science, and provide for professional courses in education as well as a sufficient number of courses for general education.

(3) The Committee hopes to stimulate the science departments of a number of colleges and universities to bring secondary school teachers to their campuses for cooperative work on their educational problems. Out of workshops and conferences held at colleges and universities would probably come plans for improved science courses. These activities would provide good in-service training for science teachers and would enable the secondary school teachers to make their problems and their points of view evident to the college scientist.

(4) The Committee offers its services as a consultant to state or local agencies working on problems pertaining to science teaching. In this way, direct connection may be provided between such agencies and the societies represented on the Committee. For example, the Committee might become associated in a curriculum study in some state, cooperating with the state department of education and the college and secondary school science teachers. The results of such a project might prove valuable to other states. On the other hand, the Committee plans to call in consultants from the teaching profession to obtain expert advice on problems related to the science curriculum in secondary schools and questions of teacher training.

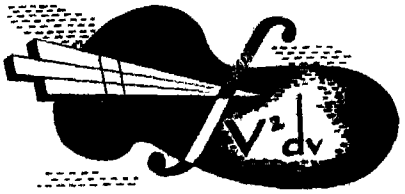
The time is ripe for important developments in science education. This Committee, by bringing together representatives of the scientific societies and by consulting with administrators, supervisors, and teachers who are concerned with the science curriculum, hopes to aid in the development of a more effective science program in this period of change.

(5) Reports will be made on the need for legislation leading to Federal *support of science teaching in the high schools*. The need for scholarships on the senior high school level is as urgent as it is on the college level. Extension of the Science Talent Search to states and recommendations for Federal support of a scholarship program are of deep concern to the Committee.

(6) The Committee will cooperate with the National Science Teachers Association and other organizations in projects for the improvement of teaching aids in science. Projects are now under way for the development of low-cost laboratory equipment, for visual aids, and for the study of teaching techniques.

(7) The Committee proposes to study possible procedures for certification of competency, with special reference to the development of instruments for appraisal of the prospective teacher.

(8) It is also planned to give serious consideration to a coordinated science curriculum in the schools, with particular emphasis on the proper grade placement of concepts and ideas.



NEWS
and Notes

The Association regrets to announce that on July 5 Dr. Otis W. Caldwell, general secretary of the AAAS and member (ex officio) of the Executive Committee since 1935, died in New Milford, Connecticut, following a cerebral hemorrhage. At the time of his death Dr. Caldwell was also serving as chairman pro tem of the Managing Committee, AAAS-George Westinghouse Science Writing Awards. He became a Member of the AAAS in 1900, a Fellow in 1902, and a Life Member in 1923. In 1925 he was vice-president of the Section on Education. For many years he worked very actively with the officers of the affiliated Academies of Science and recently had devoted a large measure of his time to the Near East Foundation, of which he was a director.

About People

William E. Purnell, Sydney, N. S. W., has been appointed counselor in charge of Field Scientific Operations for the Natural Science Section of UNESCO. Mr. Purnell will coordinate the three Field Science Cooperation Offices which UNESCO is setting up this year in Rio de Janeiro and Cairo and in China. Plans for a fourth office, to be set up in India next year, are being formulated.

Dallas B. Phemister, Thomas D. Jones professor and chairman, Department of Surgery, University of Chicago, retired July 1 but will continue at the University as Thomas D. Jones professor emeritus. Dr. Phemister was succeeded as chairman of the Department by **Lester R. Dragstedt,** professor of surgery.

T. C. Schneirla, formerly associate professor of psychology, New York University, and associate curator, Department of Animal Behavior, The American Museum of Natural History, has been promoted to curator at the Museum.

Donald S. Fleming, assistant professor of bacteriology and immunity, has been named secretary to the Faculty of Medicine, McGill University. Dr. Fleming succeeds **John F. McIntosh,** who has returned to his former position at the Royal Victoria Hospital.

Paul Campbell Young, professor of psychology, Louisiana State University, is visiting professor of psychology at Southern Methodist University, Dallas, Texas, for 1947–48.

Ray D. Owen, on leave of absence from the University of Wisconsin as a Gosney Research Fellow at California Institute of Technology, has been appointed associate professor of biology at the latter institution.

Roger H. Bray, research soil chemist, University of Illinois, addressed the annual banquet meeting of the University of Kentucky Chapter of Sigma Xi, May 9, on "The Nature of a Fertile Soil."

Frans Verdoorn, managing editor of *Chronica Botanica,* was appointed an honorary staff member of the Government Botanic Gardens, Buitenzorg, Java, at the 130th Centenary of the Garden, May 18, in recognition of his wartime work on behalf of the scientific institutions of the Netherlands Indies.

Carsten Steffens, Solvay Process Company, Syracuse, New York, has been appointed director of chemistry and chemical engineering, Stanford Research Institute.

Sheldon Clark Reed, Harvard University, has been appointed associate professor of zoology and director, Charles Fremond Dight Institute for the Promotion of Human Genetics, University of Minnesota.

Roland Wendell Harrison, dean, Division of Biological Sciences, University of Chicago, has been elected a vice-president of the University. Dr. Harrison succeeds **Lawrence A. Kimpton,** who has resigned to become dean of students and professor of philosophy, Stanford University.

Myrtle Collier, chairman, Department of Mathematics, Immaculate Heart College, Los Angeles, California, has retired as professor emeritus.

Cleveland Norcross, formerly administrative officer and recently executive secretary of OSRD, on July 1 became assistant director of the American Institute of Physics, 57 East 55th Street, New York City.

Edward Ross has been appointed associate professor in the Department of Horticulture, Washington State College, Pullman, and associate horticulturalist in the Agricultural Experiment Station for industrial research in food technology.

Visitors to U. S.

Sydney Goldstein, professor of applied mathematics, University of Manchester, England, and chairman, Aeronautical Research Council, Ministry of Supply, will be at Brown University during August and will give a series of 20 lectures on "Dynamics of Compressible Fluids." Dr. Goldstein will also lead a seminar on the same subject.

Lennart Grone, manager, Department of Agricultural Machinery, Alnarp Agricultural, Dairy and Horticultural Institute, Akarp, Sweden, is visiting this country for six months to discuss farm machinery problems with experts in this field. Mr. Grone, who has recently been visiting the Iowa State College campus, plans to extend his trip to include many of the midwestern states.

F. T. Gerson, Plastics Department, Almex Ltd., Birmingham, England, is visiting the Frederick S. Bacon Laboratories, Watertown, Massachusetts, technical representatives of Almex in this country, to study materials and methods used in the U. S. plastics industry.

Grants and Awards

Harold L. Temple and **Sydney Weintraub,** Department of Radiology, Cornell University School of Medicine, have been granted a research fund to support further studies in the field of radioopaque media. The grant has been established by the Schering Corporation, Bloomfield and Union, New Jersey.

Leo I. Dana, research manager of the Linde Air Products Company, New York, has been awarded the Jacob F. Schoellkopf Medal of the American Chemical Society's Western New York Section for his work in cyrogenics, the science of very low temperatures.

Ernest H. Volwiler, executive vice-president, Abbott Laboratories, is the recipient of the 1947 honor scroll award of the American Institute of Chemists.

The Stalin Prizes, awarded annually for outstanding accomplishments in the arts and sciences, have been received by the following scientists: N. N. Bogoliubov, professor of physics, for work in statistical physics published in 1945 and 1946; Y. I. Frankel, Leningrad Physical-Technical Institute, for research on the theory of the liquid state published in the monograph, *The kinetic theory of liquids*; M. A. Pavlov, for his work, *The metallurgy of cast iron*; A. S. Arbuzov, professor at the Kazan Chemical Institute, for research on phosphorus; N. G. Khlopin, professor at the Kirov Military Academy, for his work in the field of biology; I. P. Razenkov, for discoveries in nutrition and digestion; and S. P. Obnorsky, director of the Russian Language Institute, Academy of Science, for his published work on the history of Russian literature and language of ancient times.

The Chevalier du Mérite Agricole has been conferred by the French Government upon Henry Solon Graves, dean emeritus, Yale School of Forestry; Lyle Watts, chief, U. S. Forest Service; Edward I. Kotok, assistant chief of the Service; and Tom Gill, member of the Forestry Advisory Committee of the UN Food and Agriculture Organization.

Colleges and Universities

At recent commencement exercises in U. S. colleges and universities, the following scientists received honorary degrees: John H. Van Vleck, Harvard University, the D.Sc. from the University of Wisconsin; C. B. Huggins, University of Chicago, the M.Sc., and A. F. Blakeslee, Smith College, the D.Sc. from Yale University; Roger Adams, University of Illinois, the D.Sc. from the University of Pennsylvania; Vannevar Bush, Carnegie Institution of Washington, Louis S. Gates, mining engineer, New York City, and Harvey S. Mudd, mining engineer, Beverly Hills, California, the D.Sc. from Columbia University; W. Paul Briggs, Pharmaceutical Division, Veterans Administration, and Waldemar Kaempffert, the *New York Times*, the D.Sc. from the Philadelphia College of Pharmacy; Lloyd A. Hall, Griffith Laboratories, Chicago, the D.Sc. from Tuskegee Institute; Carroll L. Wilson, Atomic Energy Commission, the D.Sc. from Williams College; Laurence H. Snyder, Ohio State University, the D.Sc. from Rutgers University; Oswald T. Avery, Rockefeller Institute for Medical Research, the D.Sc. from New York University; Edwin H. Land, Polaroid Corporation, Cambridge, the D.Sc. from Tufts College; Columbus O'Donnell Iselin, Woods Hole Oceanographic Institute, the D.Sc. from Brown University; William A. Hamor, Mellon Institute, the D.Sc. from the University of Louisville; and E. R. Weidlein, Mellon Institute, the LL.D. from Washington & Jefferson College.

Yale University has announced the inauguration of a new course to be offered in the fall on the Development of the Sciences, which, according to President Seymour, is designed to aid in "the closer integration of the sciences and the humanities in the college curriculum and to emphasize the contribution of the sciences to liberal education." This course, which will cover two terms, has been developed by a committee consisting of Joseph S. Fruton, associate professor of physiological chemistry; Henry Margenau, professor of physics; Talbot H. Waterman, assistant professor of zoology; and Edmund W. Sinnott, director of the Division of the Sciences.

Armour Research Foundation, Illinois Institute of Technology, has announced the following promotions: M. H. Heeren, to director, Research Division, and executive chairman of the staff; Carl Titus, to director, Magnetic Recording Division; K. W. Miller, to assistant director of the Foundation; Horace Quinn, to assistant director of research; M. E. Nelson, to assistant director of international operations; and E. H. Schulz, to chairman, Electrical Engineering Research.

Baylor University College of Medicine, Houston, Texas, has announced the following faculty appointments: Russell J. Blattner, Washington University School of Medicine, as professor and chairman, Department of Pediatrics; Warren T. Brown, Yale University School of Medicine, as professor of psychiatry and chairman, Department of Neuro-Psychiatry; Russell C. Huggins, University of Georgia School of Medicine, as associate professor of pharmacology; A. S. Harris, Western Reserve University School of Medicine, as associate professor of physiology; F. B. Moreland, Kansas State Board of Health, as associate professor of biochemistry; and Dan E. Jenkins, University of Michigan School of Medicine, as assistant professor of medicine.

The University of Wisconsin has announced the retirement in June of the following faculty members: Florence E. Allen, assistant professor of mathematics; Leon J. Cole, professor of genetics; William O. Richtmann, professor of pharmacognosy; and John R. Roebuck, professor of physics.

Brown University has announced the promotion of George F. Carrier to associate professor of engineering, Graduate Division of Applied Mathematics, and S. Wing Handford to associate professor of biology. Leaves of absence for the second semester of the academic year 1947–48 have been granted to George L. Church, professor of botany, and Carl W. Miller, professor of physics.

The School of Medicine, Louisiana State University, has announced the following appointments: James D. Rives, formerly clinical professor of surgery, as professor and head, Department of Surgery, succeeding Urban Maes, who has retired as professor emeritus; Robert L. Simmons, formerly director of the Lauderdale, Mississippi, Health Unit, as associate professor of public health and preventive medicine, succeeding George W. McCoy, who has retired as professor emeritus; Sidney S. Chipman, formerly practitioner of pediatrics, Norwalk, Connecticut, as associate professor of pediatrics; Nelson K. Ordway, Yale University, as assistant professor of pediatrics; and Edwin S. Kagy, Tulane University School of Medicine, as clinical assistant professor of medicine. Joseph A. Danna and Narcisse F. Thiberge have been appointed clinical professors emeritus of surgery and medicine, respectively.

The University of Puerto Rico, Rio Piedras, P. R., has announced that it can no longer sponsor the Santiago Primate Colony, consisting of approximately 400 rhesus monkeys (*Macaca mulatta*) of different ages, located at Cayo-Santiago, about a mile from the eastern coast of Puerto Rico. Equipment consists of an adequate living house, two storehouses, land and water transportation facilities, and water system. No cases of tuberculosis have occurred there in the last six years. Institutions interested in acquiring the Colony, in whole or in part, or in assuming its sponsorship are requested to communicate with Dr. Facundo Bueso, Dean, College of Natural Sciences.

The University of Nebraska has announced that the following have been promoted to full professors: Marcus D. Weldon, Department of Agronomy; Carl E. Georgi, Department of Bacteriology; Donald A. Keys, Department of Operative Dentistry; and A. A. Luebs, Department of Mechanical Engineering.

The University of Pittsburgh has announced the following as visiting lecturers in psychology during the summer session: Lewis R. Wolberg, Victor C. Raimy, Virginia Axline, Samuel B. Hadden, Gregory Zilboorg, and William A. Hunt. The lecturers will cooperate in offering a six-week course on Approaches to Counseling, Guidance, and Psychotherapy for clinical psychologists, psychiatrists, and social workers.

Industrial Laboratories

Leeds & Northrup Company has announced that E. Burk Estabrook, of its sales department, is visiting Sweden at the invitation of the Royal Swedish Academy of Engineering Sciences and the Association of Swedish Technical Physicists. On June 5 Mr. Estabrook addressed Swedish engineering societies at Stockholm on "Automatic Temperature Control in Industrial Processes."

Carl S. Miner, founder and director of the Miner Laboratories, Chicago, has been elected to the Board of Directors, Universal Oil Products Company, Chicago.

General Electric Company is carrying out a $300,000,000 expansion program, designed to meet the increased demand for peacetime products. At Electronics Park, a $25,000,000 project to be located near Syracuse, New York, and now nearing completion, the Company will concentrate on electronics engineering, research, and production of devices in the field. Among other projects already in process or contemplated are a $20,000,000 factory building at Schenectady for the manufacture of steam turbines and electric generators; an $8,000,000 new Research Laboratory, to be completed early in 1948 at The Knolls, near Schenectady; operation for the Atomic Energy Commission of a $20,000,000 atomic power laboratory to be constructed in the vicinity of the new Research Laboratory; and construction of a $5,000,000 plant at Waterford, New York, for the manufacture of silicones.

Elections

The Society for American Archaeology has elected Frederick Johnson, Andover Academy, president; Earl Morris, University of Colorado, first vice-president; Isabel Kelly, University of California, second vice-president; and Waldo Wedel, U. S. National Museum, secretary.

The American Academy of Arts and Sciences recently elected the following Fellows: Howard H. Aiken, Arthur W. Allen, George P Baker, David L. Belding, Ruth F. Benedict, Hans A. Bethe, Richard Burgin, Thomas D. Cabot, William H. Claflin, Jr., Edward U. Condon, Paul C. Cross, John R. Dos Passos, Arnold L. Gesell, Sanford B. Hooker, Mildred McA. Horton, Mark DeW. Howe, Wilbur K. Jordan, Milton E. Lord, Ralph Lowell, Charles W. MacGregor, Lewis Mumford, Norman B. Nash, John L. O'Brian, William Phillips, Francis M. Rackemann, Ivor A. Richards, Fritz J. Roethlisberger, James S. Simmons, Richard M. Smith, Merrill C. Sosman, Clark C. Stephenson, William F. Twaddell, Shields Warren, and Sumner Welles. Foreign Honorary Members elected include: Paal Berg, Hamilton A. R. Gibb, Augustus D. Imms, Joseph Klausner, P. Maheshwari, Edward A. Milne, Alf E. Porsild, Meghnad Saha, Gregory A. Shajn, Godfrey H. Thomson, George P. Thomson, Ivan M. Vinogradoff, and Wen-Hao Wong.

The Pittsburgh Geological Society elected the following officers at its annual business meeting May 16: Shailer S. Philbrick, U. S. Engineers, president; John T. Galey, Independent Oil and Gas Operator, vice-president; David K. Kirk, Gulf Research & Development Company, secretary; and Charles H. Feldmiller, Equitable Gas Company, treasurer. Councilors elected for two-year terms are: L. Guy Huntley, consulting geologist; Chilton E. Prouty, University of Pittsburgh; and F. C. Hauber, The Peoples Natural Gas Company.

The American Society for Pharmacology and Experimental Therapeutics, at its Chicago meeting, May 18–22, elected the following officers for the coming year: Maurice H. Seevers, University of Michigan Medical School, president; Carl A. Dragstedt, Northwestern University Medical School, vice-president; H. B. Haag, Medical College of Virginia, secretary; K. K. Chen, Lilly Research Laboratory, treasurer; and J. C. Krantz, Jr., University of Maryland School of Medicine, and Hamilton H. Anderson, University of California Medical School, councilors.

The American Institute of Nutrition has elected as officers for the coming year: R. M. Bethke, president; E. M. Nelson, vice-president; N. R. Ellis, treasurer; H. E. Carter, secretary; and A. D. Holmes, councilor.

The Alabama Academy of Science, at its annual meeting in Birmingham, May 1–3, elected the following officers for the coming year: John Xan, president; E. D. Emigh, president-elect; A. T. Wager, secretary; R. D. Brown, treasurer; and E. B. Carmichael, editor of the *Journal of the Alabama Academy of Science*.

Over 100 members attended the sessions, and 52 papers were presented, J. L. Kassner, the retiring president gave the annual address at the banquet on the topic, "Science in a Changing World."

The American Institute of Electrical Engineers, at its annual meeting in Montreal, June 11, elected the following officers: Blake D. Hull, Southwestern Bell Telephone Company, St. Louis, Missouri, president; G. W. Bower, Haddonfield, New Jersey, J. H. Berry, Norfolk, Virginia, I. M. Ellestad, Omaha, Nebraska, D. I. Cone, San Francisco, California, and D. G. Geiger, Toronto, Ontario, vice-presidents; W. L. Everitt, Urbana, Illinois, A. C. Monteith, East Pittsburgh, Pennsylvania, and Elgin B. Robertson, Dallas, Texas, directors; and W. I. Slichter, New York City, treasurer.

The Louisiana Academy of Sciences, at a recent meeting held on the Louisiana State University campus, elected the following officers: George H. Mickey, Louisiana State University, president; Percy Viosca, Jr., Southern Biological Supply Company, New Orleans, vice-president; H. B. Boudreaux, Southwestern Louisiana Institute, secretary-treasurer; George Kent, Louisiana State University, acting editor; and S. J. P. Chilton, Louisiana State University, *permanent secretary*. Divisional chairmen elected were: Mary Warters, Centenary College, biological; Lorimer E. Story, Louisiana Polytechnic Institute, social sciences; John B. Entrikin, Centenary College, physical sciences; and Bert B. Boyd, Northwestern Louisiana College, junior academy.

The Crystallographic Society has reported election of the following officers: John W. Gruner, University of Minnesota, president; A. Pabst, University of California, who succeeds to president in 1948, vice-president; William Parrish, Philips Laboratories, Inc., Irvington-on-Hudson, New York, secretary-treasurer (1947–49); and Samuel G. Gordon, Academy of Natural Sciences of Philadelphia, and George Tunnell, Carnegie Institution of Washington, councilors.

The West Virginia Academy of Science elected the following officers at a recent meeting: J. E. Judson, West Virginia Wesleyan College, president; Nelle Ammons, West Virginia University, vice-president; A. H. VanLandingham, West Virginia University, treasurer; and N. Bayard Green, Marshall College, secretary.

The next meeting of the Academy will be held at West Virginia Institute of Technology, Montgomery, West Virginia, April 30–May 1, 1948.

The Medical Library Association, at its 46th annual meeting in Cleveland, Ohio, May 27–29, elected the following officers: Eileen R. Cunningham, Vanderbilt University Medical Library, president; Janet Doe, New York Academy of Medicine Library, vice-president and president-elect; Howard Dittrick, Dittrick Museum of Historical Medicine, Cleveland, honorary vice-president; Edna M. Poole, Academy of Medicine, Toronto, Canada, secretary; and Edith Dernehl, Marquette University School of Medicine, treasurer.

The 1948 convention, about which no final decision has yet been made, will mark the 50th anniversary of the founding of the Association.

At the 25th annual meeting of the Virginia Academy of Science at the University of Virginia, May 8–10, held jointly with the Virginia Junior Academy of Science, Arthur Bevan, state geologist, and president of the Academy, announced the winners of the second Virginia Science Talent Search, which was in charge of an Academy committee headed by Alfred L. Wingo, of the State Department of Education. Top winners were Edward Minter Foley of Danville, and Melissa A. Warfield of Norfolk. A $50 U. S. Savings Bond was presented to each of the 15 winners, and $10 to each of the other 27 who qualified for final judging. Joyce Stoutamyer of Front Royal and Richard A. Waterval of Alexandria were awarded memberships in the AAAS, and Audrey Moore of Newport News, Bernard Brown of Norfolk, and Julian A. Scott of Eastville were awarded memberships in the Academy for their outstanding work in the Junior Academy.

Academy officers elected for the coming year are: Jesse W. Beams, University of Virginia, president; E. C. L. Miller, re-elected secretary-treasurer; Rodney C. Berry, Virginia State Department of Agriculture, assistant secretary; and Allan T. Gwathmey, University of Virginia, Council member. Sidney S. Negus, Medical College of Virginia, Richmond, was named president-elect to succeed Dr. Beams in May 1948.

Recent Deaths

Howard Shreve Roberts, 56, physicist at the Geophysical Laboratory, Carnegie Institution of Washington since 1917, died January 30 following an operation.

Arnold J. Gelarie, 62, specialist in rheumatic diseases, and onetime assistant, Rockefeller Institute for Medical Research, died May 9 at Montefiore Hospital, the Bronx, New York.

William Letchworth Bryant, 76, director, Roger Williams Park Museum, Providence, Rhode Island, and honorary curator of Fossil Fishes, New York State Museum, died June 9 at his home in Providence after a brief illness.

Edward Clark Streeter, 72, medical historian and curator of the museum collections of the Yale Medical Library, died in Stonington, Connecticut, June 17.

Harry Seltz, 51, professor of chemistry, Carnegie Institute of Technology, and supervisor of the Manhattan District project at the Institute during the war, died June 19 at his home in Pittsburgh.

Wilfred Hudson Osgood, 71, curator emeritus of Zoology, Natural History Museum, Chicago, died June 20 in Billings Memorial Hospital, Chicago.

Herbert W. Emerson, 67, formerly director, Pasteur Institute, University of Michigan, died June 21 at Hamilton General Hospital, Burlington, Ontario.

Lorande L. Woodruff, 67, professor of protozoology and director, Osborn Zoological Laboratory, Yale University, died June 23, at his home in New Haven.

Aaron Louis Treadwell, 80, professor emeritus of zoology, Vassar College, died June 24 at his summer home in Redding, Connecticut.

Michael Joseph Callahan, 57, manager of the Fabrics Division, Fabrics and Finished Department, Du Pont Company, died suddenly in Wilmington, Delaware, on June 25.

Make Plans for—

Fifth International Pediatrics Congress, July 14–17, Waldorf-Astoria Hotel, New York City.

Symposium on Sound, July 21–22, Salt Lake Tabernacle, and University of Utah.

The American Mathematical Society, First Annual Symposium in Applied Mathematics, August 2–4, Brown University, Providence, Rhode Island.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Induction of Mutants in *Penicillium notatum* By Methyl-bis(β-chloroethyl)amine[1]

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The efficacy of allyl isothiocyanate and the sulfur mustard gas, bis(β-chloroethyl)sulfide, in the production of mutants in *Drosophila melanogaster* has been reported by Auerbach and Robson (*1*). Gilman and Philips (*5*) and Gilman (*4*) have discussed the nucleotoxic action of the β-chloroethyl sulfides and amines. Horowitz, Houlahan, Hungate, and Wright (*7*) have reported that bis(β-chloroethyl)sulfide is effective in producing mutants in *Neurospora crassa*, while Slizynski (*8*) has shown the production of structural changes in somatic chromosomes of *D. melanogaster* by treatment with allyl isothiocyanate. The chemical production of mutants in *Drosophila* has recently been discussed by Auerbach, Robson, and Carr (*2*), but detailed reports on the efficiency of the β-chloroethyl amines in producing mutants have so far not appeared.

In view of the success that has been obtained in the induction of mutants in *Penicillium* by ultraviolet irradiation (*3*), it seemed desirable to investigate the effects of compounds of the type mentioned above upon this fungus. We have studied the action of the nitrogen mustard, methyl-bis(β-chloroethyl)-amine, in producing morphological mutants in the stable strain NRRL-832 of *P. notatum*. The nitrogen mustards were selected, since they are much easier to handle in the laboratory than the sulfur mustards. The treatment consists of simply suspending the spores in an aqueous solution of the nitrogen mustard. By way of comparison we have determined the number of mutants produced by exposing spores to ultraviolet radiation.

Treatment with the nitrogen mustard[2] was carried out by adding 10 ml. of a suspension of spores of *P. notatum* NRRL-832 containing about 130,000 spores/ml. to 10 ml. of a freshly prepared solution of methyl-bis(β-chloroethyl)amine in aqueous bicarbonate buffered solution. The nitrogen mustard solution was prepared by adding 0.25 ml. of a solution containing 19.2 mg. (0.10 mM) of methyl-bis(β-chloroethyl)amine hydrochloride to 9.75 ml. of a sterile aqueous solution containing 270 mg. (3.20 mM) of sodium bicarbonate. As soon as the liberated base dissolved (about 30 seconds) the spore suspension was added, mixed, and allowed to stand at room temperature (24° C.) with occasional shaking. At intervals thereafter, 0.40-ml. aliquots were withdrawn and added to 100 ml. of a sterile decontamination solution containing 60 mg. (0.80 mM) of glycine and 68 mg. (0.80 mM) of sodium bicarbonate. The samples of treated spores and a sample of the untreated spores were stored at 4° C. for 24 hours or longer. The diluting of the treating mixture by the glycine-bicarbonate solution effectively stops the reaction of the nitrogen mustard with the spores and decontaminates the mixture by removing the unreacted β-chloroethyl groups through reaction with water or glycine (*6*). After storage, the spores were plated out in Petri dishes on an agar medium containing 6 per cent honey and 1 per cent peptone. These cultures were incubated at room temperature for 5 days, after which counts of the total number of colonies and of mutants were made. Any colony showing morphological characters such as rate of growth, color, degree of sporulation, or character of mycelium markedly different from those commonly associated with the stable strain NRRL-832, as evidenced by the colonies produced from untreated spores on the same medium, was classed as a mutant. Approximately 1,000 spores were plated out for each of the first two and 4,000 for the remaining samples of the nitrogen mustard treatment; approximately 1,000 spores were plated out in the case of each sample of the irradiated spores. The control consisted of 3,309 colonies from untreated spores. Of these, only three could be classed as

TABLE 1

INDUCTION OF MUTANTS IN *Penicillium notatum* BY METHYL-BIS(β-CHLOROETHYL)AMINE

Treatment (min.)	Survival (%)	Mutants	
		(% of survivors)	(% of original spores)
By methyl-bis(β-chloroethyl)amine			
0	100.0	0.1	0.1
1	60.1	0.2	0.1
2	41.3	1.8	0.7
4	31.5	8.7	2.7
8	8.9	19.6	1.7
16	3.6	29.5	1.1
33	2.6	44.4	1.1
By ultraviolet radiation			
0	100.0	0.1	0.1
5	81.0	2.2	1.8
10	48.6	8.9	4.3
15	24.5	20.0	4.9
20	3.6	23.3	0.8
25	1.6	15.4	0.2
30	1.2	10.0	0.1

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[1] Published with the approval of the director, Wisconsin Agricultural Experiment Station. This work was supported by grants from the Schenley Research Institute, Eli Lilly and Company, Lederle Laboratories, and the Graduate Research Committee.

[2] Since the nitrogen mustards are very toxic, all treatments were carried out in a well-ventilated hood. The operator was protected with rubber gloves and a face shield, and pipetting was done with a bulb pipette. All glassware was decontaminated by placing in a bath containing glycine and sodium bicarbonate solution for 24 hours. We are indebted to Dr. John Hutchens, Toxicity Laboratory, University of Chicago, for the nitrogen mustard.

morphological mutants. This very low rate of spontaneous mutation serves to emphasize the stability of the particular strain used.

The results of the treatments are summarized in Table 1. It is evident that the nitrogen mustard was relatively toxic to the spores and that this lethal action continued throughout the period of treatment. Furthermore, the data show that this nitrogen mustard was very effective in producing morphological mutants and that the percentage of mutants based on the number of survivors continued to increase throughout the duration of the treatment. The percentage of mutants based on the original number of spores plated out increased from 0.1 in the untreated control to 2.7 for the 4-minute treatment. This large increase indicates that the nitrogen mustard treatment actually produced these mutants and did not merely serve as an agent which preferentially allowed pre-existing mutants to survive. The subsequent decline in the total number of mutants also indicates this nonselective action.

The data obtained on irradiating a comparable spore suspension with a narrow band of ultraviolet radiation at 2,750 A. show that ultraviolet radiation of this wave length exerts a considerable toxic action and also induces mutations. However, in contrast to the nitrogen mustard treatment, the number of mutants based on the percentage of survivors reached a maximum and then declined. The maximum number of mutants produced was somewhat higher than that obtained by the nitrogen mustard treatment.

In so far as could be judged by visual examination of the colonies, there is no essential difference between the two treatments as to the types of mutants produced. Ultraviolet-induced mutants of NRRL-832 have been carried through repeated transfers without evidence of reversion to the original form. Representative mutants induced by nitrogen mustard were carried through a second transfer and some through successive transfers without observation of any change in morphological characters. Since the sexual stage of this organism is unknown, it is impossible to study the inheritance of these induced characters by the usual methods.

On the basis of the number of spores surviving treatment, it appears that the nitrogen mustard can be more effective than the ultraviolet radiation of the wave length employed in inducing mutants in this strain of *P. notatum*.

Studies dealing with the action of the nitrogen mustards on various races of *P. notatum* and *P. chrysogenum* are being continued in investigating the variability of these organisms in obtaining races showing biochemical differences such as changed nutritional requirements and capacity to produce penicillin.

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Separation and Immunologic Evaluation of Soluble Pertussal Antigens[1]

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Leslie and Gardner (*3*) demonstrated that *Haemophilus pertussis*, the causative agent of whooping cough, is monotypic and, under adverse cultural conditions, is progressively degraded from smooth Phase I to rough Phase IV strains, the latter phase being irreversible. The development of improved pertussal vaccines by Sauer (*9*) and Kendrick (*1*) followed these observations. Subsequent clinical data indicate that prophylactic efficacy is closely related to Phase I characters.

Until recently different pertussal vaccines could be evaluated only on the basis of clinical trial, since no satisfactory laboratory test existed. However, Kendrick (*2*) has now introduced an intracerebral challenge test in mice employing live Phase I organisms. It was shown that immunization intraperitoneally with a single dose of 100,000,000–500,000,000 Phase I organisms protects mice against 100–1,000 fatal intracerebral doses of live *H. pertussis*. If the assumption is made in this test that a correlation exists between mouse antigenicity and the prevention of whooping cough in human beings and, further, that the test might distinguish quantitatively the antigenic power of different pertussal vaccines or antigens, it should be possible to evaluate antigens, other than Phase I vaccine, for their prophylactic efficacy.

Accordingly, the present report concerns studies on the immunologic evaluation by the Kendrick test of soluble pertussal antigens (SA), supplied by Lederle Laboratories. The parent materials contain, among other things, detoxified thermolabile toxins (*7*), capsular or surface antigens (*5*), as well as detoxified somatic antigens (*5*). Improved methods for the preparation of parent SA will be published subsequently (*8*). The behavior of SA in methanol-water mixtures (*4, 6*) under controlled conditions of pH, ionic strength, and temperature is also presented.

The protective dose (PD_{50}) of the various antigens was determined by the Kendrick test. Groups of 10 mice each were injected intraperitoneally with 0.5 ml. of varying dilutions of SA or Phase I vaccine. After a rest period of 10 days, the mice were challenged intracerebrally with 100–1,000 fatal doses of Phase I *H. pertussis*. Control groups of 10 mice were employed to verify the adequacy of the challenge dose. The Standard Reed-Muench calculations were employed to determine the PD_{50} of the various antigens.

Nitrogen was determined in duplicate by the micro-Kjeldahl method of Pregl. Hydrogen-ion determinations were made on the glass electrode. Adjustment of the pH of SA for the fractionation with methanol was made with an acetate buffer (*4*) for hydrogen-ion concentrations less than pH 4.6, with acetic acid for pH 4.1, and with HCl for those greater than pH 4.1.

One volume of SA is chilled to 1° C. and adjusted to the desired pH with ice-cold buffer or acid and immediately transferred to $-5°$ C. bath. To this mixture the calculated amount of methanol (measured at $-5°$ C. and then chilled to $-20°$ C.)

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[1] Aided by a grant from Lederle Laboratories Division, American Cyanamid Company. Thanks are due to Frances L. Clapp and Dorothy Novotny for their aid in conducting the antigenicity tests.

is added slowly with stirring, care being taken to maintain the temperature at −5° C. The mixture is allowed to stand at −5° C.; the precipitate is removed in a refrigerated centrifuge at −5° C. and is freed of as much of the supernatant as possible by drainage. The precipitate is dissolved to 1/10 the original SA volume with ice-cold M/15 phosphate buffer of pH 7.4 and clarified by centrifugation at 4,000 r. p. m. for 15 minutes at 0° C. The purified SA samples were maintained at −30° C. until assayed.

Table 1 summarizes the results obtained with SA fractions separated between pH 2.0 and 7.0 in 40 per cent methanol at −5° C. These data indicate that the substances responsible for the protection of mice against *H. pertussis* are quantitatively precipitated (within the limits of accuracy of the test) at pH 4.1 in 40 per cent methanol. Hydrogen-ion concentrations greater than pH 4.1 lead to an increased solubility of protective substances; those less than pH 4.1 also result in a progressive loss of antigen into the supernatant fluid. On a nitrogen basis, the PD_{50} of the fraction separated at pH 4.1 has been purified about 95-fold over parent antigens. Further fractionation of this fraction has resulted in products of over 200-fold purity (*5*).

TABLE 1

Conditions		Mg. N*/ ml.	PD_{50} (ml.)	PD_{50}'s/ mg. N	PD_{50} yield (%)†
pH	Methanol (%)				
2.0	40	0.31	0.6	5	3
3.1	40	0.47	0.06	35	27
4.1	40	0.45	0.017	131	94
4.6	40	0.36	0.025	111	64
5.1	40	0.30	0.042	79	38
6.0	40	0.21	0.041	116	39
7.0	40	0.17	0.10	59	16
4.1	25	0.35	0.16	18	10
4.1	10	0.27	0.11	34	15
Parent antigens		4.55	0.16	1.4	—

* Ten times the concentration of parent antigens.

† $\frac{\text{Total PD}_{50}\text{ precipitated}}{\text{Total PD}_{50}\text{ in parent antigens}} \times 100.$

TABLE 2

Antigen	PD_{50} (ml.)	No. of Phase I organisms/ PD_{50} (billions)
Purified SA, alum precipitated	0.004	--
Purified SA, alum precipitated + 5,000,000,000 Phase I Vaccine*	0.0026	0.013
Purified fluid SA	0.017	—
10,000,000,000/ml. Phase I Vaccine*	0.015	0.150

* Lederle # 2074-21.

In other experiments it was noted that methanol concentrations under 40 per cent resulted in the incomplete precipitation of the antigenic factors. These experiments, as well as others to be reported later, suggest that two or more soluble antigens are responsible for the full protection of mice against *H. pertussis*. The above results have been duplicated with different lots of parent SA varying in PD_{50} from 0.09 to 0.29 ml.

Table 2 summarizes the results of a comparative study of the antigenic potencies of concentrated SA fractions separated at pH 4.1 in both the fluid and alum-precipitated state and of Phase I vaccine. The alum-precipitated sample is over 3 times more antigenic than the plain bacterial vaccine. The antigenicity of a mixture of alum-precipitated SA and 5,000,000,000 Phase I organisms was 5 times as great as that of the vaccine. Concentrated fluid SA compares favorably with a 10,000,000,000 Phase I vaccine.

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Some Effects of Ultraviolet Light on 2, 4-D and Related Compounds[1]

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Studies of the action of ultraviolet light on plant growth-regulating compounds have been limited. In 1938 Gilman, in studying the effect of ultraviolet light on unsaturated compounds (*3*), reported that ultraviolet light changed trans-cinnamic acid to a mixture of cis-cinnamic, truxillic and truxinic acids. A year later, Zimmerman and Hitchcock (*5*) showed that the relatively inactive trans-cinnamic acid could be changed to the active cis-cinnamic acid by ultraviolet light. Other workers have noted the effect of light on naturally occurring growth substances. It was shown by du Buy in 1933 (*2*) that white light (not specified) plus heat decreased the growth substance supply in the *Avena* coleoptile. The work of Boysen (*1*) suggested that auxin-a is inactivated, at least in part, by white light but that heteroauxin (indole-3-acetic acid) is not.

The objective of the study reported here was to determine the effect of ultraviolet light on 2,4-D, the sodium, ammonium, and triethanolamine salts, and the methyl, ethyl, and butyl esters. Also included were studies on 2-methyl-4-chlorophenoxyacetic acid. These compounds were selected because they were the active ingredients in most of the hormone-like herbicides available during 1945–46. The results of such a study should assist in the interpretation of comparative field tests when these compounds are used as weed killers.

The chemicals used in this study came from several sources. The 2,4-D (m.p., 139°C.) was prepared in the laboratory of the Chemistry Section, Colorado Agricultural Experiment

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Station. This was dispersed in Carbowax 1500. The ammonium salt of 2,4-D was obtained from the Du Pont Semesan Company. The monohydrated form of the sodium salt was obtained from the J. T. Baker Company. The 2,4-D dispersed in triethanolamine was made in this laboratory by dispersing purified 2,4-D in 10 times its weight of triethanolamine. The methyl ester used was the Dow Chemical Company product called Dow-G-652 and contained 22.75 per cent of the ester. The ethyl ester was the 1945 product (Formula No. 2) of the Sherwin Williams Company. This contained 75 per cent of the ester. The butyl ester was the Sherwin Williams Company 1946 product ("Weed-no-more 40"), which contained 40 per cent by weight of the ester. The compound 2-methyl-4-chlorophenoxyacetic acid was the 1946 Du Pont Chemical Company product called "Methoxone," which contained 85 per cent of the active ingredient.

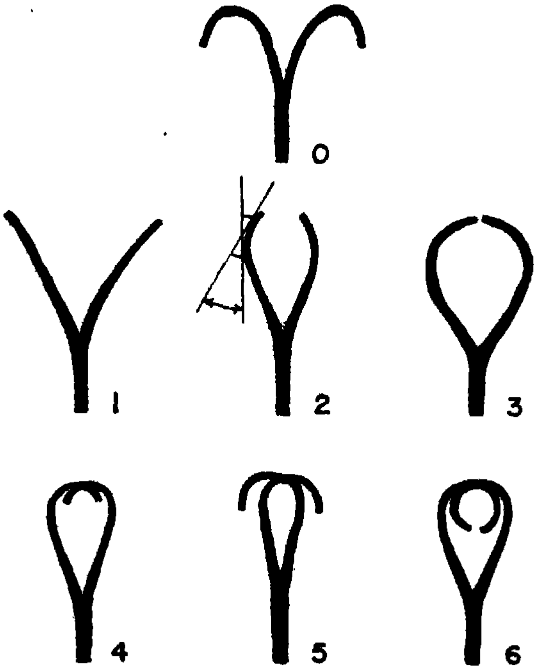

FIG. 1. Pea-stem growth-curvature classes: 0 = zero inward curvature, typical of distilled water; 1 = slight inward curvature; 2 = tips parallel to and inward curvature of 45°; 3, 4, 5, 6 = average inward curvatures between 45° and 90°, between 90° and 135°, between 135° and 180°, and greater than 180°, respectively.

Samples of all chemicals were treated by placing them in sterilized Petri dishes and irradiating for a 12-hour period. The layer of material in each case was approximately 2 mm. thick. At hourly intervals each dish was stirred, shaken, and leveled. Two sources of light were employed: a GE Mazda mercury-arc lamp, type A-H4, with a 100-watt capacity, used without a filter, and the same type lamp of 250-watt capacity, used with a black light filter. The two standard filters used were Nos. 5860 (51) and 5970 (41). Separate series of each chemical were treated with each filter. Transmission measurements of the filters were made in the Physics Department, Colorado Agricultural Experiment Station. It was found that the range of No. 5860 (51) was between 3,407 and 3,888 A., with a peak at 3,600 A.; that of No. 5970 (41), between 3,306 and 4,000 A., with a peak at 3,700 A. and a small amount of transmission in the red between 6,800 and 7,500 A. Transmission in the ultraviolet for No. 5860 (51) was 35 per cent and for No. 5970 (41), 45 per cent.

Among the numerous biological tests for measuring the growth-regulating properties of organic chemicals are those involving measurements of root-growth inhibition, epinastic response, and growth curvatures of the oat coleoptile and of the split stem-tips of peas. Went's pea test (4) was selected for this study because it provided an adequate number of observations for statistical study and because of the ease of obtaining uniform plants.

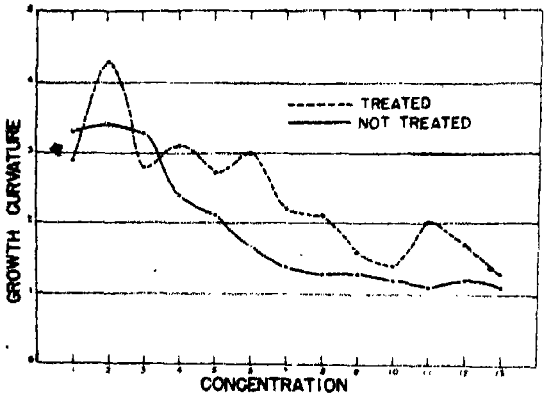

FIG. 2. Pea-stem growth reaction curves of 2,4-D and of the same compound treated with ultraviolet light (3,407-3,888A.).

For each compound, four pea tests (one for each light treatment and control) with 13 concentrations were used, and 10 pea stems were employed in each concentration. Each compound was irradiated according to the three treatments described above.

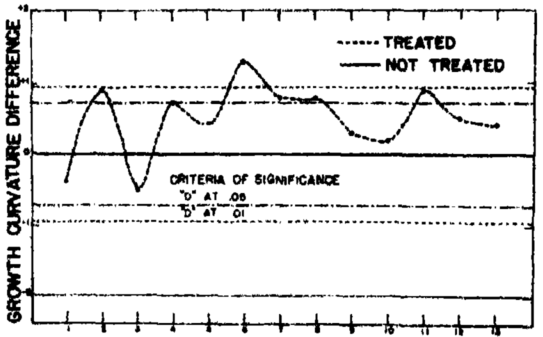

FIG. 3. Criteria of significance of the growth-curvature differences of data shown in Fig. 2.

All solutions were made on a molar basis, such that the weakest concentration (No. 1) corresponded to .000029 M and the strongest (No. 13) to .122000 M. The highest concentration was made by direct weighing and making up to volume; all others, by diluting in such a manner that each succeeding dilution was one-half the concentration of the preceding one. This particular series of concentrations was selected because of the relationship to the sodium salt of 2,4-D expressed in parts per million, *i.e.* concentration No. 1 corresponds to 8 ppm and No. 13 to 31,942 ppm.

The growth curvature of each pea stem was classified according to the system indicated in Fig. 1.

In studying the growth curvature results for each compound, variance analyses were made for each treatment with its control (chemical without light treatment), in order to eliminate error due to treatments and within treatments. Then the criterion of significance of difference, or d-value, between means of each pair (treated chemical and untreated) was found. To facilitate the reading of these differences, graphs were made of those between the two means at each concentration, and the criteria, or d-lines, were drawn at the .05 and .01 levels. This procedure is illustrated by the pea reaction curves for 2,4-D and for the same compound treated with ultraviolet light (filter 51) Figs. 2 and 3. A similar procedure was used to study the effect of ultraviolet light on all other compounds investigated. Results and their significance are summarized in Table 1.

TABLE 1

Chemical	No.	Light treatment	Concentration												
			1	2	3	4	5	6	7	8	9	10	11	12	13
2,4-D	31	Mercury arc	I **	** I **	S **	* I **	* I **	I	S	0	I	I	I		
		Filter 41	I	I **	I	I *	I	I **	*	*	S	I	S **	S	S
		" 51	I	S	I	S	S **	S	S **	S **	S *	S	S	S	S
Sodium salt of 2,4-D	124	Mercury arc	S **	S	S	S	S	S	S **	S **	S	S	I	S	S
		Filter 41	I	I	I	S	S	S	I *	I	I **	I	S	I	I **
		" 51	S	S			S	S	S	S	S		S	I	I
Butyl ester of 2,4-D	150	Mercury arc	F value not significant												
		Filter 41	" " " "												
		" 51	* S	** S	S	S	* S	I	I	S		I			
Ethyl ester of 2,4-D	151	Mercury arc	F value not significant												
		Filter 41	" " " "												
		" 51	" " " "												
Methyl ester of 2,4-D	184	Mercury arc	" " " "												
		Filter 41	" " " "												
		" 51	" " " "												
2,4-D dispersed in triethanolamine	152	Mercury arc	I		I	** I	** I	I	** I	** I	** I	I	I	* I	** I
		Filter 41	F value not significant												
		" 51	S	S **	I	I	S	S	I	S	S	S	S	S	S
2-methyl-4-chlorophenoxyacetic acid	204	Mercury arc		I	I	I		I	I	S	S	S	S	S	S
		Filter 41	F value not significant												
		" 51	* S **	S **	**	* I **	0 **	I **	** S **	** S **	S **	** S **	** S	* S	
Ammonium salt of 2,4-D	149	Mercury arc	I	I	I	I	I *	I **	I **	I	I	I	I		*
		Filter 41	I **	I **	I **	S **	S	I **	I **	S	I	I	I	I	I
		" 51	I	I	I	I	I	I	I	S	I	I	I	I	I

The letter I indicates inferiority of the irradiated chemical; the letter S, superiority. A single asterisk indicates significance at the .05 level; a double asterisk, at the .01 level.

The trend of these results indicates that ultraviolet light of the range and intensity described, when transmitted by filter 51, can be used to activate 2,4-D, the sodium salt, the butyl ester, and 2-methyl-4-chlorophenoxyacetic acid. Comparative tests of the herbicidal effects of these chemicals activated with ultraviolet light and those of untreated chemicals are suggested.

It is recognized that, with the exception of 2,4-D, pure compounds were not used in this investigation. Possibly purified salts and esters might give different reactions than the impure commercial mixtures used. Had this work been done first on the purified compounds, the question of its action on commercially available herbicides would still have been unanswered, and this was the question of immediate importance.

The results further suggest a possible explanation of the variable results secured from uniform trials of 2,4-D and similar compounds at different times and places. Since the amount of ultraviolet light reaching the earth varies with change in atmospheric conditions, altitude, and season of the year, the herbicidal effects might be expected to vary accordingly. Field tests designed to settle this question are suggested.

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Utilization of Vitamin A in Water Emulsion

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The utilization of vitamin A is to a large degree dependent upon the quality of its carrier oil, in which it is dissolved (*3*). The utilization of vitamin A in vegetable oil and in water emulsion was studied during an investigation of the effect of peroxides on vitamin A absorption in chicks.

The vitamin A was derived from two different gray fish-liver oils of similar potency. Oil #1 was freshly prepared, while oil #2 had undergone considerable oxidation during long storage. The characteristics of the oils (*2*) are collected in Table 1.

TABLE 1

Physicochemical Characteristics of the Two Gray Fish-Liver Oils

	Oil #1	Oil #2
Vitamin A estimate at 325 μ (unsaponifiable)...	8,330	8,271
Ratio $E^{1\%}_{1\text{cm}}\ \frac{260}{325}$ "...........	0.236	0.330
" " $\frac{280}{325}$ "...........	0.347	0.446
" " $\frac{300}{325}$ "...........	0.656	0.728
" " $\frac{350}{325}$ "...........	0.466	0.478
Vitamin A estimate at 328 μ (whole oil)........	8,160	9,000
Ratio $E^{1\%}_{1\text{cm.}}\ \frac{260}{328}$ "...........	0.326	0.738
" " $\frac{280}{328}$ "...........	0.420	0.807
" " $\frac{300}{328}$ "...........	0.690	0.883
" " $\frac{350}{328}$ "...........	0.574	0.565
Peroxide value..........................	0	16.7
Free fatty acid..........................	0.23	0.67

Each of the oils was diluted with refined sunflower seed oil (peroxide value, 2.75; f.f.a., 0.3 per cent) and with water to potencies of both 50 and 150 units/cc., based on the vitamin estimate on the unsaponifiable fraction. The water emulsions were prepared by using 1 per cent "methocel" (400 centipoise) as the emulsifying agent. The oils and water for the preparations were deaerated, saturated with nitrogen, and stabilized with 0.05 per cent mixed tocopherols and 0.1 per cent soybean lecithin. In addition, the water phase of the emulsions was stabilized with 0.05 per cent gallic acid. Oils and water emulsions were stored in a cool place until ready for use. The emulsions were thoroughly shaken before use to ensure uniformity.

To determine the efficacy of the vitamin A in the carriers a biological assay was carried out with chicks, using essentially the technique described by Biely and Chalmers (*1*). Nine groups of 15 New Hampshire pullet chicks were standardized by weight at 7 days and then fed the vitamin A solutions by pipette (per os) every other day. Four of these groups were fed at the rate of 25 units/day, four others received 75 units/day, and the remaining one was kept as a negative control (Table 2). The chicks which were fed the water emulsions of vitamin A were given 1 cc. of sunflower seed oil, one day after vitamin A feeding, to equalize the fat intake in the different groups. The chicks were weighed once a week for 7 weeks, and a record of mortality and autopsy findings was kept. Table 2 shows the results of the experiment.

It will be seen from Table 2 that all groups of chicks receiving the vitamin A in the form of a water emulsion grew at a markedly greater rate than those fed vitamin A in oil. Since the basal diet appeared to supply all the necessary nutrients (including the vitamins) in adequate amounts with the exception of vitamin A, it would appear that the critical factor in these studies was the kind of carrier in which the vitamin A was supplied. Experimental data obtained in this laboratory (*4*) show also that a watery emulsion of vitamin A, when mixed in feed, produced slightly better growth in chicks over a period of 7 weeks than a feeding oil which had herring oil as a carrier.

TABLE 2

Weight of Chicks Fed Vitamin A in Different Carriers

Group	Units/cc.*	Description	Days 7	30	37	44	51	Total mortality
			(Grams)					
1	50	Vitamin Oil #1 in vegetable oil	67.3	279.8	326.0	383.9	400.1	1
2	50	Vitamin Oil #2 in vegetable oil	68.3	278.0	289.6	327.1	349.5	5
3	50	Vitamin Oil #1 in water emulsion	66.1	306.6	378.4	448.9	467.6	0
4	50	Vitamin Oil #2 in water emulsion	67.3	295.8	325.9	400.3	416.9	0
5	150	Vitamin Oil #1 in vegetable oil	67.3	312.7	408.6	507.4	549.3	1
6	150	Vitamin Oil #2 in vegetable oil	66.4	303.3	377.0	461.6	495.9	0
7	150	Vitamin Oil #1 in water emulsion	67.0	347.1	451.0	578.5	616.1	0
8	150	Vitamin Oil #2 in water emulsion	65.0	329.3	407.5	534.6	575.4	0
9	0	Control (no vitamin A)	67.0	All dead	—	—	—	15

* Fed 1 cc. every second day in all cases.

Examination of the data also shows that fresh gray fish-liver oil, whether fed in oil or as water emulsion, resulted in somewhat greater growth than oxidized gray fish-liver oil.

The above experiment is being repeated on a larger scale in order to obtain sufficient data to determine statistically the extent of the differences between the two vitamin A carriers. The preliminary findings reported here show that the use of water emulsions of vitamin A can be of theoretical and practical importance in the biological assay of vitamin A with either rats or chicks, and in the field of nutrition—especially in those cases where fat metabolism is disturbed.

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Natural Formation of Petroleum-like Hydrocarbons From "Oil Shales"

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In many localities throughout the area of the exposed lacustrine Green River facies of the continental Eocene of Colorado, Utah, and Wyoming are exposures of porous and permeable rocks containing a viscous liquid hydrocarbon. This material, soluble in CS_2, CCl_4, ether, and petroleum solvents, has apparently been produced naturally from the enveloping "oil shales."

The best of these porous and permeable beds are several thin, 2 inch to 14 inch layers of volcanic ash (*1*), now largely altered to crystalline analcite and chalcedonic silica. Several of these layers are regionally persistent, but locally there are present from 15 to 36 additional such ash layers ranging from 1/32 inch to 20 inches in thickness. These are intercalated with the organic marlstones or "oil shales" of the Green River beds. Some of these beds, ranging in porosity from 15 to 20 per cent and having a permeability of from 7 to about 30 millidarcys, are enveloped by beds of rich organic marlstone. Standard porosity and permeability tests made on samples of this rich marlstone give results approaching zero, but there is enough permeability along the bedding planes of the material in place for sodium carbonate efflorescence to form on a fresh surface in a month's time.

In areas where there has been no appreciable tectonic activity, these beds of altered volcanic ash are commonly free from all traces of either (1) petroleum-like liquid hydrocarbons soluble in the usual solvents or (2) pyrobituminous material such as is contained in the "oil shales."

However, in local areas of rather moderate folding, such as is encountered near the Grand Hogback in Colorado or along Evacuation Creek in Utah, and in some areas of more gentle dips, some of the less stable, yellowish, amorphous kerogen of the "oil shales" adjacent to these porous analcitic layers has been transformed to a dark brown, waxy, semifluid hydrocarbon. This material fills the pore spaces of the analcitic beds and also the joint cracks of the enveloping "oil shales."

This hydrocarbon is identical with the heavier cuts of shale oils produced from the Green River "oil shales" by usual retorting methods. This may be an intermediate step in the production of gilsonite by inspissation of such hydrocarbons produced by natural (geothermal?) cracking of the pyrobitumens present in the organic marlstone of the Green River lake beds. A substance identical to gilsonite can be produced in the laboratory from "oils" of the type described above.

The above occurrences are offered as field evidence of the existence of such natural "cracking" of pyrobitumens into a liquid hydrocarbon superficially resembling some types of petroleum.

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Plasma Accelerator Factor and Purified Prothrombin Activation[1]

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Recently attention was focused on the presence of a substance in plasma which accelerates the activation of prothrombin (*1, 6*). Partial purification of this factor has made available a product useful for the study of prothrombin activation (*6*). The newly-recognized factor is a plasma globulin which we refer to as Ac-globulin.

We mentioned in 1938 that partially purified prothrombin is slowly converted to thrombin in the presence of optimum amounts of calcium and thromboplastin (*4*). Such slow activation is illustrated by curve A of Fig. 1. When a small amount of Ac-globulin (Y concentration) is first added to the prothrombin, the activation rate of the latter is increased, as shown by curve B. With 2Y, 10Y, and 40Y concentration of Ac-globulin the activation rate is further increased, as illustrated by curves C, D, and E, respectively. Finally, with 90Y concentration of accelerator the activation rate is virtually equal to that of native plasma prothrombin itself (curve F). Heretofore it seemed likely that slow activation of purified prothrombin was the result of damage done to the fragile molecule during the purification procedures. This work shows, however, that it is necessary only to supply Ac-globulin in order to activate

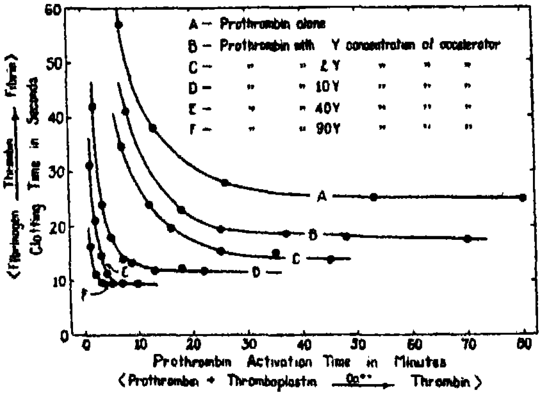

Fig. 1. Activation of purified prothrombin with optimum amount of thromboplastin and calcium. Only Ac-globulin concentration was varied.

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[1] Aided by a grant from the National Institute of Health.

purified prothrombin in the same manner as prothrombin not handled by various laboratory manipulations.

The curves of Fig. 1 also show that the *quantity* of thrombin obtained from purified prothrombin is increased by addition of the plasma factor. As the Ac-globulin concentration is increased, the following changes occur: first, both the rate of activation of the prothrombin and the thrombin yield increase; next, the activation rate shows the predominant increase, but thrombin yield still improves; finally, only activation rate increases, but there is no longer a significant increase in thrombin yield. This sequence of events is the pattern obtained when changes in pH, calcium concentration, NaCl concentration, and other variables are made to interfere with the optimum interaction of prothrombin and thromboplastin (*2*). Whenever activation rate is appreciably reduced, the eventual yield of thrombin is also reduced. Presumably this is due to the fact that side reactions have time to produce their effect. It has been shown, for example, that partial activation of purified prothrombin yields a substance, very likely thrombin, capable of destroying prothrombin (*3*).

Through experimental approaches of this kind it has been possible to obtain a preliminary quantitative conception of Ac-globulin concentration and its function. Normal plasma contains the factor in generous quantity. We must, however, simultaneously consider prothrombin concentration. The current viewpoint is that a bleeding tendency develops when this drops below 10 per cent of normal. It is now apparent that this tendency can be accentuated by a low Ac-globulin concentration. On the other hand, a high concentration of Ac-globulin can compensate for a low prothrombin concentration by forcing rapid production of thrombin and, therefore, quick clotting of blood.

The prothrombin used in this work was prepared by $(NH_4)_2SO_4$ fractionation, as described previously (*5*). It possessed a maximum specific activity of 23,000 units/mg. tyrosine. The Ac-globulin was also purified by methods previously described (*6*). Prothrombin activity was measured by the two-stage method.

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IN THE LABORATORY

Use of Polyvinyl Alcohol[1] to Preserve Fecal Smears for Subsequent Staining

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Fecal samples are often sent for diagnosis to distant laboratories, either preserved with formalin or phenol or in an unpreserved condition. These procedures are adequate for the subsequent identification of any protozoan cysts and helminth forms present, but protozoan trophozoites are almost always destroyed or rendered unrecognizable.

This note describes a method which makes it possible to submit trophozoite material in fixed smears on slides, to be stained and examined when received at the diagnostic laboratory. A fixative is embodied in water-soluble polyvinyl alcohol, which then serves the dual purpose of fixing the fecal smear and forming a temporary mount during shipment.

The mounting medium is prepared by dissolving, in a water bath, 20 grams of powdered Elvanol in the following solution: saturated aqueous solution of mercuric chloride, 130 cc.; 95 per cent alcohol, 60 cc.; glacial acetic acid, 50 cc.; and phenol, 50 cc.

Preparation of smear for shipment. A thin fecal smear is prepared on a clean slide in the usual manner. The smear should not be permitted to dry. It is then covered with a generous amount of the Elvanol solution, using a medicine dropper, and a cover slip applied as in ordinary mounting. In from 2 to 4 hours, depending upon the quantity of solution used and the room temperature, the slide will be dry enough for mailing in any container in which the smears will not be subject to pressure.

Removal of mounting medium prior to staining. The slide is soaked in a 5 per cent aqueous solution of glacial acetic acid at 60°–70° C. until all of the Elvanol film has been dissolved from the smear and the cover slip drops off. This usually takes about 15 minutes. The slide is then rinsed in tap water for 3 minutes and stained in the usual manner with iron-alum hematoxylin. Most organisms will stain as they do following ordinary fixation, except for a tendency to require longer destaining in the differentiating solution.

Preliminary experiments show that protozoan cysts and trophozoites as well as helminth eggs are well preserved by this method. Fecal smears prepared in this manner may be submitted to the laboratory with a reasonable assurance that the intestinal parasites present will be recognizable following staining with iron-alum hematoxylin.

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[1] The product used by us is specified as "Elvanol 90-25" (formerly "polyvinyl alcohol, Grade RH-349-A, Type B, medium viscosity"), obtainable from the E. I. du Pont de Nemours & Company, Electrochemicals Department, Niagara Falls, New York.

Elimination of the False Positive Reaction With Human Sera in Complement Fixation Tests[1]

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In a recent paper DeBoer and Cox (*5*) reported that complement fixation tests for the diagnosis of eastern and western equine encephalomyelitis employing infected chick embryo antigens as described by the author (*1*) or the mouse brain antigens of Casals (*4*) were not truly specific in that these tissues fixed complement with known positive human syphilitic sera. This phenomenon had been described previously by Wertman, who used normal yolk sacs or chick embryos (*7*). DeBoer and Cox described a procedure for extraction of the antigens in the lyophilized state with benzene, toluene, or dichlorethylene, which eliminated the so-called false positive reactions. Twenty-two individual and 14 pools of syphilitic sera were tested. The authors failed to mention the temperature of inactivation for these human sera, merely referring to the method of Kolmer and Boerner (*6*) for the technique of the complement fixation test in which 55° C. for 20–30 minutes is recommended.

TABLE 1

EFFECT OF INACTIVATION TEMPERATURE ON COMPLEMENT FIXATION TESTS

Serum	No.	Titer with irradiated chick embryo antigens								
		56°C.—30 min.	60°C.—15 min.							
			0	1/4	1/8	1/16	1/32	1/64	1/128	1/256
Pos. syphilitic	6	1/64	5	1						
" "	14	1/128	9	4		1				
" "	8	1/256	3	2	2	1				
Neg. "	3	1/16	2	1						
" "	2	1/32	2							
" "	1	1/128					1			
WEE immune	4	1/256							4	
EEE immune	1	1/64				1				
"	2	1/128						1	1	
"	1	1/256						1		

Casals (*2, 3, 4*), using infected mouse brain antigens, has repeatedly stressed the importance of different temperatures of inactivation according to the species of serum under test and recommends 60° C. for 20 minutes with human sera. In this laboratory, complement fixation tests employing irradiated antigens derived from infected chick embryos have proved satisfactory in the detection of antibodies for eastern and western equine encephalomyelitis viruses provided the sera are properly inactivated. Although temperatures of 55° or 56° C. are acceptable for some animal sera, they are definitely unsatisfactory for human sera. In a series of tests with 34 human sera obtained from the syphilis clinic, false positive reactions were obtained in titers ranging from 1/16 to 1/256 when the sera had been inactivated at 56° C. for 30 minutes. When these same sera were treated at 60° C. for 15 minutes, 21, or 61 per cent, were completely negative, and the titers of the remainder were reduced from 16- to 64-fold. On the other hand, sera containing antibodies for eastern or western equine encephalomyelitis viruses either retained their original titers or dropped only 2-fold or 4-fold after being inactivated at 60° C. Table 1 presents these results. Obviously, the vast difference in the capacity of specific sera to resist this higher temperature of inactivation provides a qualitative diagnostic criterion. This remarkable difference of only 4° C. is best illustrated by the following example: A pool of positive syphilitic human sera heated at 56° C. gave a false positive reaction with the chick embryo antigen to a titer of 1/64 after as long as 120 minutes at that temperature. When this identical pool was subjected to a temperature of 60° C., the titer was reduced to 1/16 after 5 minutes, 1/8 at 10 minutes, and was completely negative after 15 minutes inactivation.

The simple expedient of inactivating human sera at 60° C. for 15 minutes instead of 56° C. for 30 minutes, when used for complement fixation tests with antigens derived from chick embryos, makes unnecessary the elaborate techniques suggested by DeBoer and Cox for purifying virus antigens.

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Apparatus for Continuous Yeast Culture

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A simple batch type of continuous culture apparatus which provides a daily series of freshly grown yeast cultures for experimental use was developed and used during studies on yeast metabolism (*7, 9*). This apparatus is useful in reducing to a minimum daily, time-consuming culture manipulations. A rubber stopper-glass tubing joint permits the rapid and aseptic withdrawal of part of all of the culture and assures its continuation by immediate renewal and automatic reinoculation of the medium.

The apparatus is inexpensive and easily constructed, from glassware and supplies available in most laboratories, to suit various capacity requirements. It is easily dismounted, cleaned, resterilized, and returned to operation, and is adaptable to various types and shapes of culture vessels.

The apparatus should prove useful in the continuous serial batch cultivation of any aerobic organism capable of multiplying when suspended in a liquid medium. Agitation of the suspension sufficient to distribute nutrients and oxygen and remove metabolic end-products is considered important to high crop yield (*1*, *8*). While air-flow agitation alone does not always establish optimum aeration conditions in this type of culture, addition of vigorous mechanical agitation tends to do so (*1*, *3*). Pure oxygen flow alone, however, would result in conditions more nearly equivalent to those existing at the surface of an agar plate (*7*, *8*). The apparatus described here fulfills such requirements at an intermediate aeration level in a simple form. It avoids the disadvantage in methods of the type described by Moor (*6*) and Klem (*4*), in which cells are permitted to sediment in a thick layer, and it is simpler and less expensive for small-scale cultures than the mechanically agitated apparatus described by Feustel and Humfeld (*3*). Other simple culture vessels which provide extensive aeration agitation are described by Magoon and Brunstetter (*5*) and Stier and Stannard (*10*).

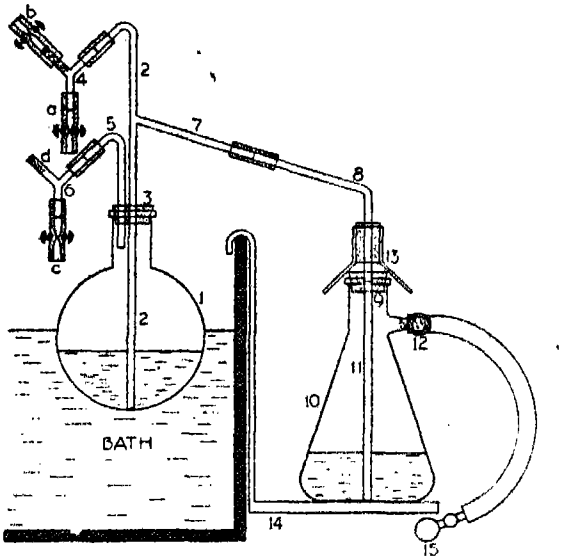

Fig. 1

Fig. 1 shows a diagram of the apparatus set up with an ordinary boiling flask as the culture vessel. The parts required for one unit are one culture vessel, glass Y- or T-connections, a glass powder funnel, a supply of filter flasks fitted with one-hole rubber stoppers, spring-type pinchcocks, glass tubing, and rubber stoppers and tubing of suitable type and size.

In preparing the apparatus the parts may conveniently be handled as three separate units. The openings of the vessels and the intravessel tubing are covered with heavy paper. Several filter flasks, 10, each containing a predetermined amount of medium and equipped with a rubber stopper, 9, glass tube, 11, and a cotton air filter in or attached to side tube 12, are covered with paper caps. The three units are then autoclaved.

A series of cultures is begun by assembling the units with ordinary aseptic precautions. The medium in one filter flask is inoculated. The paper cap is removed from the powder funnel, 13, and the free end of tube 8 is inserted *halfway* into the rubber stopper to contact tube 11. This is the rubber stopper-glass tubing joint mentioned above. The joint has proven stable with a tight friction fit and may be improved by cementing tube 11 into the stopper with a latex preparation.

Connection to a source of washed and moistened air or oxygen is made through side tube 12. Slight gas pressure forces the inoculated medium through the aeration-siphon tubes, 8, 7, 2, into the culture vessel. Exhaust gases are vented through tubes 5 and 6. Cotton air filters at 4b and 6d prevent airborne contamination of the culture during siphoning operations. Pinchcocks at 4a and 4b prevent loss of medium through the upper limb of tube 2 during transfer from flask 10 to the culture vessel. Moisture traps and drains are provided at 4a and 6c to prevent soaking of the cotton filters by moisture condensing in tubes 4 and 6.

Powder funnel 13 protects the joint in stopper 9 from airborne contamination. The funnel is held on tube 8 by a piece of rubber tubing which is fastened into the funnel by use of liquid latex. The funnel should slide on tube 8 to permit a snug fit on different rubber stoppers. The movement required is slight. The rubber tubing supporting the funnel is prevented from adhering to tube 8 by lubricating with glycerol or powdered graphite before autoclaving.

Samples or the whole culture may be withdrawn at will by using tubes 2, 7, and 8 as a siphon. The siphon is started by removing the gas-supply tube and applying slight suction at side tube 12 or slight gas pressure at 6d. Siphon action can be instantly stopped by opening pinchcock 4b, thus "breaking" the liquid column at the junction of tubes 2 and 7.

Reinoculation is accomplished by "breaking" the siphon before all of the culture is withdrawn. Amounts of inoculum varying in size from the few drops of liquid left on the walls of culture vessel and siphon tubes to any larger amount desired may be obtained. A very small amount of the initial inoculated medium or sterile renewal medium may fail to transfer from the filter flask to the culture vessel. This amount is usually negligible. However, substitution of a dry, sterile filter flask unit after transfer of the medium prevents any difficulty at this point. After withdrawing samples of culture and before attaching a flask of fresh medium, the end of tube 8 is flamed.

Rubber parts made of neoprene give better service than natural rubber. Plastic tubing such as Tygon (S22-1), which is somewhat transparent, should be an improvement over rubber. The apparatus is sufficiently rigid so that only the culture vessel and filter flask need support. The joint between tubes 7 and 8 was included to give the aeration siphon flexibility when changing filter flasks. A gas manifold, 15, attached under the shelf as shown is convenient for operating parallel cultures.

A reservoir for sterile culture medium attached to the aeration siphon may be substituted for the supply of medium-containing filter flasks (*2*).

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Book Reviews

An introduction to mathematical genetics Lancelot Hogben. New York: W. W. Norton, 1946. Pp. xii + 260. (Illustrated.) $5.00.

It has been said that no branch of knowledge has become a science until it has been placed on a quantitative basis. However much we may question this view in its application to the general field of biology, we can entertain no doubts of its truth in the special case of genetics. Experiments in hybridization were common enough before Mendel, but they were gropings in the dark, counting for little because they aimed at something beyond attainment by any of the methods used. Mendel changed all that and founded the science of genetics, by showing the way to give hybridization experiments direction and meaning. Biologically, his fundamental innovation was the concept of the particular determiner or factor, in terms of which inheritance was capable of simple description. But this idea would have been of little avail without the means of translating the biological properties of the factor into the numerical properties of the population. Only by these quantitative means could he test his theory and his successors elaborate it.

Mendel's mathematics were simple, both in his derivation of the ratios to be expected from the theory, for which purpose he used the binomial expansion, and in his statistical reduction of the experimental data for testing their agreement with these expectations. Indeed, his statistical treatment consisted of little more than the calculation of the ratios from his data and the recognition that sampling error would lead to these observed ratios only approximating those expected. Later, with very little elaboration these simple methods satisfied all the needs of the early geneticists. Indeed, the algebra of the binomial theorem was often replaced by the simpler, if more tedious, geometry of the checkerboard.

If mathematical genetics had rested at this stage, there would have been found little about which to write; but, as time went on, elaboration became necessary. New statistical methods were needed for the adequate testing of ratios and for the calculation of linkage values from F_2's. Also, the simple methods were no longer enough when geneticists turned their attention to the wider fields of inbreeding, assortative mating, equilibria and change under mutation and selection, and the measurement of gene frequencies in naturally-breeding populations such as man. The ensuing mathematical developments are especially associated with the names of Fisher, Haldane, and Wright; but many others have contributed, and the literature is both extensive and scattered. Prof. Hogben, in a book which is based on a course given to postgraduate students of the University of Wisconsin, has brought many of these results together and attempted to make their derivation intelligible even to those geneticists whose mathematical background is limited.

The book falls into three parts. In the first the author lays the foundation, both genetical and mathematical, for his later treatment. He considers certain basic genetical conceptions, such as those of gene frequencies and mating systems, and illustrates them and their applications by reference to models made with playing cards. The mathematical introduction is more elaborate and includes accounts of certain algebraic series and their manipulation, the calculus of finite differences as used in handling these series, and the binomial expansion, both complete and incomplete.

These foundations having been laid, attention is turned in the second part to the effects of selection, assortative mating and inbreeding, mutation, and isolation. This section is prefaced by some remarks on what the author calls the limitations of mathematical genetics. They are concerned with the principles of gene expression and their effects on the validity of the mathematical findings. The treatment is most comprehensive in regard to the types of selection and systems of mating covered, but their consequences are considered only as they apply to single genes. Systems of genes are not dealt with. As we might expect from the author's own interests, the special problems of human genetics are well to the fore in both treatment and example.

The third part consists of two appendices, one on tests of significance and the other on statistical estimation. These topics are dealt with in a more mathematically thorough than a practically comprehensive way. The most valuable method of testing significance in genetics is by the use of X^2. Yet this is not granted any mention. Again, the method of maximum likelihood is presented without any account of its value in dealing with fragmentary and combined data. It is impossible, of course, to deal adequately in 43 pages with the statistical methods used in genetics, whether from the mathematical or the analytical point of view. Such a brief account should be omitted if space forbids a more comprehensive survey.

The space gained by an omission of the appendices might well have been devoted to developing further the mathematical treatment of genetical situations, which forms the main theme of the book. As we have seen, the topics taken up are discussed thoroughly, but their range is limited. Neither Fisher's treatment of the theory of selection nor Wright's of the composition of populations is included. Admittedly, both are necessarily complex but cannot be neglected on that account.

Formal genetics, the study of hereditary transmission, has shown us how the genotype is built up of the units we call genes, and how these units can change and recombine to give variation of the genetic structure. We are now seeking to enlarge on this foundation, on the one side to understand how the genes themselves are built up and how they act in development, and on the other to understand the genetical composition of populations in all their variation, both natural and under domestication. When we consider, for example, the problems posed by heterosis and its efficient use in agriculture, it is clear that there is still much ground to cover. Our knowledge is as yet almost entirely empirical. To achieve genetical understanding we must work out the properties not only of single genes, but of systems of genes—genes which are not separable in analysis, but which can reinforce and balance one another in variation. Prof. Hogben, like Mendelian genetics itself, takes us only part way, because, as we saw, he deals with genes only one at a time. He shows us how to cope with the problem of red and white cows in our herds of black and white Friesians. He does not tell us how to cope with the problems of their milk production.

The student will find that this book well repays study. There are a few misstatements of genetical fact, as when it is said that in *Primula* species individuals homozygous for the thrum gene are nonviable, and a few of mathematical scope, as when it is stated that the recombination value can be estimated from F_2 data only when it is the same in both sexes. Nevertheless, this book is unique in the genetical ground it covers and in the attempt to explain the mathematical methods used. Having mastered it, the student will have a deeper insight into the formal properties of mating systems and the formal workings of selection, the principles of which, as Prof. Hogben suggests, are basic to the application of genetics in agriculture and human affairs. Before he can cope with the problem of applied genetics, however, the student will have to learn how these principles are used in a wider variety of situations, in some of which genetical complexity at present precludes mathematical rigor.

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The birds of North and Middle America. (Pt. X.) Herbert Friedmann (commenced by the late Robert Ridgway). (U. S. National Museum Bull. 50.) Washington, D. C.: Government Printing Office, 1946. Pp. xii + 484. (Illustrated.) $1.25.

The present volume, Part X of a monumental catalog of birds of North and Middle America, is concerned with the order *Galliformes*, including the families *Cracidae*, *Tetraonidae*, *Phasianidae*, *Numididae*, and *Meleagrididae*. The scope of Ridgway's and Friedmann's work is indicated by its subtitle: *A descriptive catalog of the higher groups, genera, species and subspecies of birds known to occur in North America, from the Arctic lands to the Isthmus of Panama, the West Indies and other islands of the Caribbean Sea, and the Galápagos Archipelago.*

Volumes in this series deal with description, range, and synonymy, but not with life history. The series, therefore, serves to complement A. C. Bent's *Life histories of North American birds*, also published by the U. S. National Museum. Bent, however, deals only with the birds of the United States and Canada, whereas the present series is concerned with the birds of the entire North American continent and adjacent islands. This more comprehensive treatment is invaluable to the systematic ornithologist who is concerned with continent-wide distribution of races, species, and genera.

As with many other bird orders, the problem of races in the *Galliformes* is a difficult one, and the author must exercise his own choice and judgment in the treatment which he accords them. For example, the present volume, quite naturally, follows the revision of Aldrich and Friedmann in treating the ruffed grouse (*Bonasa umbellus*). There are other systematists who do not agree with this revision. Further, although the racial treatment of the Bob-white (*Colinus virginianus*) has recently been extensively revised by Aldrich, the present volume does not follow his revisions.

In order of appearance, this series of bulletins has virtually reversed the presently-accepted A.O.U. Check-list arrangement. Part I catalogs the *Fringillidae*, and later parts treat other groups in reverse order. Two additional parts now in preparation, or awaiting publication, and dealing with the orders from *Falconiformes* to *Gaviiformes* will complete the catalog.

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ASSOCIATION OF VITAMIN CHEMISTS, INC. (Eds.) *Methods of vitamin assay.* New York-London: Interscience, 1947. Pp. xviii + 189. $3.50.

BRAND, LOUIS. *Vector and tensor analysis.* New York: John Wiley; London: Chapman & Hall, 1947. Pp. xvi + 439. $5.50.

CHERONIS, NICHOLAS D., and ENTRIKIN, JOHN B. *Semimicro qualitative organic analysis.* New York: Thomas Y. Crowell, 1947. Pp. xiv + 498. (Illustrated.)

DANN, W. J., and SATTERFIELD, G. HOWARD. *Estimation of the vitamins.* (Biological Symposia, Vol. XII.) Lancaster, Pa.: Jaques Cattell, 1947. Pp. 531. (Illustrated.) $6.50.

EDDY, SAMUEL, OLIVER, CLARENCE P., and TURNER, JOHN P. *Guide to the study of the anatomy of the shark, necturus, and the cat*, and *Atlas of outline drawings for vertebrate anatomy.* (2nd ed.) New York: John Wiley; London: Chapman & Hall, 1947. Pp. vii + 115. (Illustrated.) $2.00 ea.

FISHBEIN, MORRIS. *A history of the American Medical Association, 1847 to 1947.* Philadelphia-London: W. B. Saunders, 1947. Pp. xvi + 1226. (Illustrated.) $10.00.

JOHNSON, MARTIN. *Time, knowledge, and the nebulae: an introduction to the meanings of time in physics, astronomy, and philosophy, and the relativities of Einstein and of Milne.* New York: Dover, 1947. Pp. 189. $2.75.

PRATT, LYDE S. *The chemistry and physics of organic pigments.* New York: John Wiley; London: Chapman & Hall, 1947. Pp. vii + 359. (Illustrated.) $6.00.

SZENT-GYÖRGYI, A. *Chemistry of muscular contraction.* New York: Academic Press, 1947. Pp. vi + 150. (Illustrated.) $4.50.

VESTINE, E. H., *et al. Description of the earth's main magnetic field and its secular change, 1905–1945.* (Publ. 578.) Washington, D. C.: Carnegie Institution of Washington, 1947. Pp. v + 532. $2.50, paper; $3.00, cloth.

WAKSMAN, SELMAN A. *Microbial antagonisms and antibiotic substances.* New York: Commonwealth Fund, 1947. Pp. ix + 415. (Illustrated.) $4.00.

WELCHER, FRANK J. *Organic analytical reagents.* (Vol. II.) New York: D. Van Nostrand, 1947. Pp. xi + 530. $8.00.

Technical Book Publishing in Europe, 1947:

Impressions From Visits to Eleven Countries

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CAN THE SWISS PUBLISHERS SUCCEED the German and dominate Europe as they did during the Reformation and in the 18th Century?

Will German publishers in science and technology, encouraged by the help of the U. S. and British governments in stabilizing the national economy, revive in this generation to their pre-Nazi status?

Will expanding use of English in Europe provide permanent new audiences for U. S. and British technical publishers?

With Britain spending $18,000,000 annually through its Council to influence world-wide circulation of British books, what should the U. S. Congress appropriate for State Department aid to our Information Library program, in which science and technology are the leading subjects in demand?

These are only a few of a host of questions that stir the imagination of an American technical book publisher returning to New York after 9 stimulating weeks in 11 European countries.

Contacts with publishers, educators, librarians, and book dealers were made on a plane of reciprocal interest, which was well expressed in part of the letter of introduction from the late editor of *Science*, Willard L. Valentine, written just before his death: "We are anxious to know the progress of research in the various scientific fields, the plans for reviving scientific publishing, both in the book fields and scientific journals, and the extent to which faculties and laboratory facilities are now operating in comparison with prewar standards. The American Association for the Advancement of Science and its editors are most anxious to be of service to scientists everywhere, and we shall feel honored if you will give us the opportunity to be of assistance to you, your staff, and your organizations."

In presenting this report, which is necessarily brief because of travel time and space limitations, this correspondent wishes to record his awareness of probable omission of important items. Special thanks are due the Publishing Association executives who supplied statistical data, and also U. S. Embassy staff members. It is hoped that the material may be helpful in accelerating reciprocal relations, including translations, especially for the aid of those who may not be bilingual, and that this modest effort may also be helpful in the larger movement for better international understanding.

As in the United States, World War II has released a vast flood of energy and funds for research in Europe. Just before leaving England I noted that the British government had announced the appropriation of £250,000 (to rise later to £350,000) annually for research in mechanical engineering. In Sweden new plans were announced for coordination of bibliographical material on research. In France new publications, including one on research in nutrition, were discovered, and, as implied above, Switzerland is newly acclaimed in technical publishing.

GREAT BRITAIN

In Great Britain an American feels thoroughly at home in attempting to appraise the technical publishing situation. The paper shortage, the lag in numbers of scientific personnel, the surge of new subject matter to be published, and the postwar revival of book output are, in varying degrees, similar to our own problems.

Typical of this is the spirit of the program of the British Association for the Advancement of Science meeting at Dundee, August 27–September 3, 1947. The Council decided that, in order to emphasize the positive contribution of science to human progress, the program should conform to the general theme, Swords to Ploughshares. In the corridors there undoubtedly will be much discussion, as there would be at home, of the Government bill for original scientific work, with its appropriation of £74,000,000. The proportion for research is said to be more than the government prewar expenditure for education. Men of science are increasingly concerned about an imbalance in the proportion of government- to nongovernment-sponsored work, and there is an active body of opinion which calls on scientists and universities to refuse to accept contracts which include a ban on the publication of results.

British research programs will go forward rapidly with respect to equipment availability, according to Secretary Lowe of the British Association, but during the next 10 years, great effort will be expended in meeting the requirements of the Barlow Report: to double the rate of output of scientists and also to comply with the standards of the Percy Report on Higher Technological Education. As in the United States, problems of housing, buildings, and teacher personnel are serious.

International collaboration among scientists and the potential results for publishers are emphasized in current meetings. Just now available, for example, is the first volume of the new annual series of Symposia of the Society of Experimental Biology, *Nucleic acid*. This comprises 19 papers presented at Cambridge in 1946, the authors of which are residents of Belgium, Denmark, England, Scotland, Sweden, and the United States. The second volume, to contain the papers presented at the 1947 symposium, will be entitled *Growth in relation to differentiation and morphogenesis*. In the preface the Society expresses indebtedness to Imperial Chemical Industries, Ltd., the Rockefeller Foundation, and the British Council for Financial Aid.

TABLE 1

British Technical Book Production: Output Figures*

Subject	1939	1940	1941	1942	1943	1944	1945	1946
Aeronautics	53	90	118	159	148	88	67	66
Archaeology	58	39	21	12	17	14	9	18
Astronomy	41	29	15	19	21	16	18	27
Botany, horticulture, & agriculture	200	95	92	76	58	56	73	102
Chemistry & physics	120	101	43	62	52	72	69	102
Engineering	168	139	91	158	101	132	112	198
Geology	48	32	12	19	18	11	20	17
Mathematics	54	32	35	28	46	18	37	64
Medicine & surgery	498	374	238	303	212	238	256	321
Philosophy & science	145	143	71	90	62	61	79	96
Nautical	84	51	32	15	14	22	19	41
Technical handbooks	228	132	103	110	104	118	123	253
Veterinary farming & stockkeeping	33	24	37	46	73	67	60	96
Wireless	23	26	17	40	34	31	20	33
Totals	1,753	1,307	925	1,137	960	944	962	1,434

* From Whitaker's Cumulative Book Lists, which are cumulations of the weekly and monthly book lists appearing in *The Bookseller* of London, the British book trade paper. The figures refer to books published at 6d. and over.

Similar possibilities for publishers are apparent in the report in *Nature* (April 26, 1947) of the revival in Paris, in January 1947, of the International Union of Physics. Fifteen European countries were represented, plans were made for a September 1948 meeting in Holland, liaison with UNESCO was indicated, and Commissions with personnel representing also the United States were appointed as follows: (1) Cosmic Rays, (2) Units of Radioactivity, (3) Symbols, Units, and Nomenclature, (4) Thermodynamics, and (5) Optics. Representatives were also appointed to Joint Commissions on Physicochemical Data, Viscosity, The Ionosphere, and Radiometeorology. Prof. Fleury, director of the Institut d'Optique, is secretary.

These international projects compare with similar developments in the United States. For example, there is the new *Review of Applied Mechanics*, a project for abstracting the world's literature on the subject which is to serve as a successor to the German publication, *Zentralblatt*, published before the war by Springer in Berlin. Sponsored by such bodies as the American Society of Mechanical Engineers, the U. S. Navy, and the National Research Council, under the editorship of Stephen Timoshenko for its initial issues, and with correspondents throughout the world, it aims to fill an important gap in a field of great importance today.

According to Edmond Segrave, editor of *The Bookseller*, British book publishers in the period 1939–1946, inclusive, reflect in the statistical record (Table 1) a trend toward technical book developments similar to that in the United States. In 1939, out of 14,904 books published, 1,753 were classed as technical and scientific. In 1946, out of 11,411, there were 1,434. The most significant gains were in the fields of engineering, mathematics, technical handbooks, and veterinary science, farming, and stockkeeping; the greatest declines, in botany, horticulture, and agriculture; medicine and surgery; and geology.[1]

Over-all figures of British book production show the effects of the war. For the years 1939–1946, inclusive, these are: 14,904; 11,053; 7,851; 7,241; 6,705; 6,747; 11,411.

Shortages of labor and materials, emphasized by the fuel crisis, continue to plague the industry and cause frustration in the effort to meet the great postwar demand for new books, particularly of a technical and educational nature. Prior to the fuel crisis of last winter, publishers' allotments had been increased to 90 per cent of prewar, but conditions this spring required another 10 per cent reduction. On the other hand, just as in the United States, increased book production costs, with resulting increase in prices to the public, were thought to be a probable cause of reduction in public demand and an automatic solution of the problem of shortages.

Limitations for another two years were anticipated by the president of the Publishers' Association in his annual address in March. In the quota control, the attitude toward relative value in different fields of publishing is given in the following percentages of tonnage allotments of paper in the 12-month period prior to February 1947: medical, 15; general, 14; scientific and technical, 15; educational, 30; religious and dictionaries, 11; legal, 3.

Participation of the British publishers in the national export drive is shown by the fact that in 1946 book sales abroad exceeded £5,000,000, compared to £3,000,000 before the war. Representatives of Ernest Benn, Ltd., stated that British technical publishers with substantial stocks report an unprecedented world demand for British technical books.

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[1] Since there is no standardization of publishing terminology, of classification of subject matter, or as to when a pamphlet becomes a book, these and succeeding statistical materials cannot be used to compare records of production in different countries.

FRANCE

The record of intellectual production to a total of nearly 9,000 volumes in 1946, or more than any year since 1938 and double the low period of Occupation in 1941, is shown in Table 2. Science and technology have maintained a steady, if not impressive, rate. The statistics, however, do not reflect the struggle to secure paper and binding materials.

TABLE 2

FRENCH INTELLECTUAL PRODUCTION*

Subject	1938	1940	1941†	1942	1943	1944	1945	1946
I General works	353	153	56	80	131	334	641	31
II Religious literature	558	377	260	603	529	676	475	781
III Philosophy	238	158	176	325	410	367	236	359
IV Pure sciences‡	424	371	319	531	520	564	310	425
V Medicine‡	501	391	234	409	1,023	688	300	371
VI Techniques, games, & sports‡	1,044	882	458	803	1,272	1,361	910	1,129
VII Juridical & social science‡	1,140	690	530	1,090	1,227	1,080	716	1,135
VIII History & geography	1,158	864	558	947	998	1,053	828	1,400
IX Archaeology, fine arts	411	199	159	265	258	351	231	279
X Literature, language	2,297	1,315	1,138	955	1,550	2,206	2,341	2,982
Total	8,124	5,400	3,888	6,008	7,918	8,680	6,988	8,892
Translations of foreign works	1,056	676	119	322	130	81	190	421

* Statistics furnished by the Cercle de la Librairie.

† In occupied zone of France only.

‡ Additional figures on translations taken from the *Bibliographie de la France*, February 21–28, 1947:

	IV	V	VI	VII	Total of IV–VII	Grand total
German	2	1	1	3	7	49
English	2	1	5	6	14	237
Spanish	1	—	—	—	1	13
Russian	—	—	1	9	10	59
Total on above 4 languages	5	2	7	18		
" " all languages	6	2	7	22		

Beranger, though publishing more new technical books than before the war, is concerned primarily with getting the old books back into print. In subject matter his program is about as before. There is a heavy demand for both new and old books, but high prices probably will cause reduction in circulation. The number of translations is greater than before the war.

Dunod is publishing more than before the war and exploring new fields as demands arise. Some foreign paper is purchased, but when this is allocated to a publisher, he must in turn agree to export a certain percentage of the books in which it is used.

Le Soudier reports that demands for technical books exceed supply and that new subjects are being covered. He feels that there is a strong tendency for English to become the second language in France.

At the Centre Nationale de la Recherche, where J. Wyart directs the publication of the well-known *Bulletin Analytique*, a periodical which attempts to abstract or review briefly the world's literature of science and technology, both books and periodicals, announcement has recently been made of two new journals of technical bibliographical materials: *Archives des sciences physiologique*, edited by a committee of which G. Schaeffer is president, and *Annales de la nutrition et de l'alimentation*. The editorial committee of the latter is headed by Emile F. Terroine; the editor is Georges Kersaint. Both offices are at Centre de Documentation du C.N.R.S., 18 rue Pierre Curie, Paris 5.

It is Prof. Wyart's committee of professional people in technology which in 1946 prepared the agenda for an ideal program of translation of the best U. S. literature of industrialization. Another professional committee, selected in New York by USIBA, submitted an ideal bibliography in the winter of 1946–47, and the publishers involved thereafter forwarded to the Wyart committee sample copies and terms. Having been chairman of the original USIBA committee of publishers and responsible for the contacts in Paris in 1945, I am pleased to report that although shipping difficulties greatly delayed examination of books, work on the project is in process, and developments later will indicate whether this plan for putting large-scale translation programs in the hands of professionals is practical or whether it is better to leave to technical publishers, on the usual commercial or competitive basis, the whole question of selectivity.

SWITZERLAND

In Switzerland, an impressive record of developments in new book publication has occurred since 1938. Grand totals of 2,162 and 3,949 for the years 1938 and 1945, respectively, include for science totals of 239 and 472, or slightly more in percentage of growth than for the nontechnical fields. Officials in both publishing and bookselling believe this growth will continue. Representative of the Swiss viewpoint is the following statement by a prominent librarian in Zürich:

> Since the 19th Century the printing and the sale of most of Swiss scientific literature had been in the hands of well-known German publishers. They disposed of means and organizations which enabled them to make the work of their authors popular in a far wider circle than Swiss publishers in their isolated country ever could do. Only a few authors of their international importance—for instance, the famous psychologist, C. G. Jung, or the master of modern architecture, Le Corbusier—did stick to Swiss publishers. But in most cases the powerful German publishers surpassed their modest Swiss colleagues. With the

advent of the war, things began to change. The production of Swiss books began with publication of books about law, economics, philosophy, theology, and medicine, which promised a satisfying market in their own country, as addressing themselves to a large circle of interest. During the war people came to realize that books, and especially scientific books, are a mighty weapon in the defense of independence. So the older and some of the newly-founded publishing houses in Switzerland began with a serious and vast planning of literary production also in all sections of exact and technical sciences. For 1946 the statistics are not yet available, but a further rise in quantity and quality is expected. The Swiss publishers are anxious to export a part of their production to help the international exchange of knowledge.

Among the leading Swiss publishers of technical books are the following: Verlag Hallwag A. G., Breitenrain 97, Bern; Verlag Leemann & Co. A. G., Stockerstr. 64, Zürich; Schweiz. Druck- & Verlagshaus, Klausstr. 35, Zürich; Verlag Birkhäuser A. G., Elisabethenstr. 15, Basel; Orell-Füssli-Verlag, Nüschelerstr. 22, Zürich; Archimedes-Verlag, Kreuzlingen; Editions Rouge & Cie. S. A., rue Haldimand 6, Lausanne (French); and Editions Payot S. A., rue Bourg 1, Lausanne (French).

HOLLAND

In Holland, where the ravages of Occupation are outwardly, at least for the visitor, being obliterated and the industrious citizens are most actively at work to restore the national economy, book publishing is no exception to the rule. In 1938 publications totaled 6,172 and in 1939, 6,554. In 1944, only 1,847 titles appeared and in the following year, 2,436. It is officially estimated that for 1946 the 1939 total will be repeated and also that the number of translations will be increased. Statistical reports for 1939 show that, in scientific and technical subjects, total numbers of titles issued were as follows: geography, 102; physics, 199; biology, 85; anthropology, 143; physical training, 96; and psychology, 126. In 1939, in the total of 730 translated works, 421 were from the English and 144 from German sources. It is significant that in the total output of translations from other languages the percentage of those from the German was 2.2 in 1939, 12.5 in 1944, and 2.1 in 1945, *i.e.* after the liberation.

In 29 cities in the Netherlands there are well over 100 publishers, the number involved in technical publishing being relatively small. Muelenhoff of Amsterdam is currently publishing a series of technical manuals prepared especially for the 25,000 employees of the great Phillips works at Eindhoven, manufacturers of X-ray and other forms of electronic equipment.

Unique in Dutch publishing circles is the current appearance in English, from the press of H. Stam (Haarlem), of *Ballistics of the future*, by Kooy and Uytenbogaart, which is based on data collected by the authors at The Hague, where the Germans manufactured and launched the V-2 bombs. The American edition will be distributed in early autumn of 1947.

In Holland, as in many European countries, the publishing and book-distributing organizations provide an excellent example of cartelization, in successful operation for over 100 years. Rules for pricing, converting foreign to domestic book prices regardless of bank rates, permitting newcomers to establish a business, and similar controls which in the U. S. are prohibited by Federal laws are here accepted as a sound social philosophy. The conflict in their and our concepts of business ethics or business influences on a national economy provides interesting subject matter for debate.

In many respects, the Dutch show more evidence of industry and vigor in recovering from the enormously costly and tragic period of Nazi Occupation than certain other countries, and, in publishing, their record will warrant constant study.

ITALY

For the following report, I am indebted to Carlton Washburne, director of the U. S. Information Service at Milan, and his staff, including Mr. Castellani and Miss Ferguson:

> During the war all the Italian publishers, and in particular those specialized in scientific and technical publications, experienced serious difficulties. Many firms were damaged by air raids: We mention, among the most important, Hoepli and A. Vallardi of Milan, which were completely ruined; UTET of Turin and F. Vallardi of Milan, which were seriously damaged. Besides this, the shortage of paper and electric power considerably hindered the continuance of publishing, and the division of Italy in two parts (north and south of the Gothic line) further complicated the situation. As soon as the war ended, the Italian publishers immediately started supplying the country with the cultural equipment necessary for the reconstruction. Thanks to the help of the Psychological Warfare Board of the Allied Forces it was possible to overcome the initial difficulties due to paper shortage. Today paper production is almost normal, but its cost has greatly increased (about 1:63 in respect to prewar prices). At the same time (see Fig. 1) printing and other costs have increased 1:50, while the capacity of absorption of the market does not permit an increase in sale price of more than 1:35, and generally even less (25–30 times). The consequence is a considerable reduction of the publishers' profits.
>
> It is quite natural that in these conditions the production of books has decreased in Italy. From 1938 the general total of 9,736 publications descended in 1945 to 4,068 units (the lowest figure being the total of 1,795 units for the year 1944), and, though complete information on 1946 is still missing, it seems that the total of 1945 has not been surpassed. In 1945, however, the proportional number of technical and scientific books issued (1,336) marks a little progress in comparison with that of prewar years (33 per cent of the total, instead of the constant prewar percentage of 30). This fact indicates that the present demand for such books in Italy is comparatively rather higher than before.

Among the most important books recently issued one must mention, above all, reprints of works that had become unavailable during past years as a result of war damages as well as for other reasons, *i.e.* racial laws, political persecution, etc. But also the publication of new works marks a satisfactory revival... In the total of production, translations represent a low percentage, owing to the difficulty of obtaining translation rights at satisfactory terms.

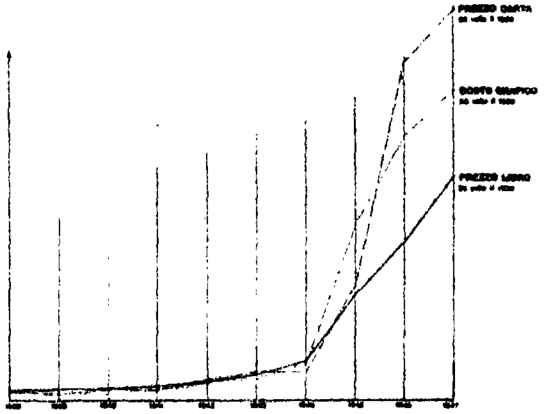

FIG. 1. Graphical presentation showing relationship of price of paper —·—·—, cost of printing ...., and selling price of books ———, 1938–47 (from *Gornale della Libreria*).

The situation is much more difficult in the branch of scientific and technical reviews and periodicals. Their number has diminished considerably. A firm of Milan, which before the war published a dozen periodicals, now publishes only one.

Besides the above–mentioned firms, and other smaller but well-known publishers of technical and scientific books (like Zanichelli and Cappelli of Bologna, CEDAM of Padua, Tamburini of Milan, Pozzi of Rome, the young firm CEA of Milan, and many others), there are also large companies specializing in the sale of such books and periodicals, such as the Hoepli Bookstores of Milan and Rome and Sperling & Kupfer of Milan.

The Hoepli firm, which is in its third generation of family operation, sponsored a list of 5,000 titles before the war, 70 per cent of which were technical. All plates were lost when the entire plant was destroyed by bombs. Today the list, including 500 "restorations," totals 1,200, of which 95 per cent are technical. In attempting to meet current needs for books on construction, small manufacturing, road building, and other timely subjects, the firm confesses to the necessity of following a policy of "practical idealism" more than heretofore. Unique in use of modern technique is a new set of art books in which color photography of famous ancient frescoes reproduced by offset printing will greatly aid art and architectural students throughout the world in studying early Italian art work.

Publisher Villardi, also a victim of bombing, shows courage in investing, under the circumstances, in a new 7-volume work on building construction.

SWEDEN

Extensive industrial utilization of scientific research is an outstanding current development in Sweden, and plans for publication of results in monograph form were recently announced by Ely Velander, chairman of the Royal Swedish Academy of Engineering Research.

Acta Polytechnica is the name of the new periodical and, since it will be published in English, French, and German, world-wide circulation is planned. As a nonprofit enterprise, its circulation will be largely on an exchange basis. It will aim to present the most important contributions made by Swedish scientists in engineering research. Unique among its features will be inclusion of library index cards. This development is part of a large national plan, sponsored by the government and in process of organization since World War I, for providing a technical information service on a large scale. It would seem to command definite interest on the part of technical editors and librarians throughout the world.

Of the 5,298 books published in Sweden in 1939, 2,284 were technical, medical, and scientific. In 1945 the total was 5,509, including 2,319 in these categories.

Outstanding in current technical book publishing is the appearance of the Swedish edition of the 5-volume engineering handbook, *Hütte*, edited by A. C. Stromberg and published by Nordisk Rotogrvyr. An edition of 7,000 copies at $10.00 per volume, excellently printed and bound, is a splendid example of publishing courage for a market that is relatively limited.

In the outstandingly attractive bookshops, in the extensive library of the Polytechnic High School, and from second-hand information about the various research laboratories in Stockholm and Upsala, it was clear that since World War II American technical book authors have firmly established themselves where formerly German authors were predominant.

BELGIUM

An orgy of spending immediately following the liberation resulted in overexpansion of book publishing and distributing facilities in Belgium, and the necessary rebound is affecting book publishing. Since few technical books are produced here, the authors preferring French imprints, since the trade association has no statistical information, and since registration of new books is not required as in other countries, our report is comparatively valueless.

POLAND

Although Warsaw was not visited on this trip, we are indebted to the March 29 issue of the *Bookseller* (London) for the following information on Polish book production last year. As will be seen, over one-third of the new titles are in the several branches of science and technology:

> Book production in Poland during 1946 totaled 3,248 titles. Although this figure is only 51 per cent of the 1937 total, it nevertheless represents a remarkable achievement, if the technical difficulties and the shortage of paper and plant are taken into account. The 3,248 titles have been classified as follows:

Books on general subjects	170
Philosophy	44
Religion	235
Social science	708
Languages and philology	29
Science	83
Technology	444
Art	164
Belles Lettres	600
Children's books	330
History and geography	320
Textbooks	121

> What the category "Books on General Subjects" contains is not clear, and it seems rather odd that the classified statistics, which are official ones, make no mention whatever of fiction.
>
> The publishers have been divided into the following classes:
>
> (1) Publishing Cooperatives (Ksiazka, Czyteknik, Wiedza, Nasza Ksiegarnia and others), 550 titles.
>
> (2) State publishing institutes, 712 titles.
>
> (3) Social organisations, trade unions, etc., 572 titles.
>
> (4) Private publishing firms, 1,414 titles.

CZECHOSLOVAKIA

Conditions of restoration in Prague are different from those in any other country visited. An official of the Ministry of Information reported that in 1946 approximately 8,000 titles were published, but the percentages of technical books and of pamphlets were not indicated. The great total was due to the fact that, during the 6-year "blackout" (1939–45), nothing was published, and since only a few books appeared in the period 1934–39, an enormous thirst and backlog was created. It was assumed that in 1947 the total would equal that of the preceding year.

With new publishing permissible only on government licenses for each book, conditions are far from normal in the opinion of an American publisher. Furthermore, with Russian the official second language, as a substitute for the German to which the adult population is, of course, well accustomed, there is for the time being some difficulty in the training of the younger generation.

In the Ministry of Education and among native industrialists and several active book dealers it was evident that educational and scientific literature from the United States was in active demand among the Czechoslovakian people.

GERMANY

Technical publishing in Germany has been discussed with respect to chemical literature by Rogers Adams (*Chem. eng. News*, February 25, 1946, p. 454; March 25, 1946, p. 790).

My brief visit to Gen. Clay's headquarters on June 1, 1947, permitted discussion only of general policy on translations from English and contractual relations between the Army Military Government and the publishing industry. Until there is a peace treaty between the United States and Germany, direct financial agreements between German and U. S. publishers become violations of the Trading With the Enemy Act. In view of the extreme shortage of paper and the priority involved in book needs for the general public, it is unlikely that problems of translation of U. S. technical books into German will be under consideration for a considerable period in the future.

DENMARK

Conferences with Nils Bohr, of the Research Laboratory of Applied Physics, and Henrick Dam, of the Biological Laboratory of the Technical High School, indicated that these men, both holders of the Nobel Prize, were definitely interested in my report of attempts to develop, through both memberships in professional societies and the exchange of literature, closer relationships between Danish and U. S. scientists.

Another interesting development was in meeting Ejnar Munksgaard, publisher of the famous Facsimile Series of volumes containing reproductions of original manuscripts dealing with early periods of civilization. The object of these volumes is not only to make accessible to researchers the chief literary sources but also to preserve them in the best reproductions it is at present possible to produce, should a catastrophe occur.

Publications emanating from research work in pure and applied science in Denmark, as well as volumes reflecting the developments in the social sciences in this part of the world, are providing an important new literature.

In providing the accompanying table of scientific book production for Denmark (Table 3), Dr. Munksgaard added the following statement:

> As to the extent of publishing scientific works in English, it is a rather difficult question. Nearly all scientific Danish papers have a summary in foreign languages, either English or German, if they are published in Danish. This has always been the rule. I should say that there is a definite tendency to publish in a foreign language in order to give the book a wider scope.

He comments on the influence of paper shortage and labor difficulties as follows:

> The lack of paper during the past years has certainly influenced the output of books in a decisive way. In 1947 the

output will be even smaller because of the strike of the typesetters which has now lasted for three months. All the planned books in either English, French, or German—about 90 per cent in English—will be printed, however, so that 1948 will be a record year as regards publication, as the typesetters cannot go on striking indefinitely.

TABLE 3

Scientific Works* Published in Denmark

	1939	1940	1945	1946
General works on books, bibliography, library economy, archives	5	8	10	10
Encyclopedias, collected essays, periodicals, societies, museums	8	12	11	7
Philosophy (logic, psychology, ethics, philosophy of religion, history of philosophy, history of science)	7	8	10	10
Religion (bible, dogmatics, mission, history of Christian Church, Christian Churches and sects, non-Christian religions)	26	15	15	17
Social science in general, statistics, political science	9	7	4	15
Insurance and public aid	3	3	2	16
Economics	16	15	9	13
Law	23	15	15	23
Administration	1	0	1	1
Education	10	7	8	6
Folklore	11	12	4	5
Geography and topography	53	54	46	45
Reports of the Greenland Administration	32	18	14	16
Pure science	2	4	2	4
Mathematics	2	5	9	5
Astronomy	4	4	5	8
Physics	4	7	21	15
Chemistry	4	7	3	6
Geology, meteorology, hydrography	14	15	12	10
Biology	17	8	8	5
Botany	11	15	3	16
Zoology	14	20	18	14
Ethnography	1	1	0	3
Medicine	59	48	56	58
Agriculture (incl. reports from the State Research Laboratory)	53	58	32	36
Useful arts (engineering, trade, business, chemical and mechanical technology)	10	19	16	15
Fine arts (architecture, sculpture, painting, engraving)	11	5	10	14
Theatre and music	6	8	4	4
Literature (general and single countries)	32	29	20	19
Philology	13	11	7	10
History	31	20	21	23
	492	438	396	449

* Only scientific works in the strictest sense are included.

NORWAY

Publishing in Norway is distinctly for the large number of works in English. A unique feature of one of the new books by Tanum is the inclusion, in a series of vertical marginal notes for the Norwegian whose bilingual ability is limited, of the translation of key words.

Mr. Moller, of the Tanum store, and Mr. Raabe, of Cammermeyer's, publishers as well as operators of two outstanding book distribution agencies of the Scandinavian countries, are well known to American publishers and distributors. It is their opinion that, until Norwegian authors have been able to complete research work which was stopped during the war, there will be few original technical manuscripts for publication. Similarly, Norwegian publishers are operating under a handicap due to paper rationing, shortage of labor, and worn-out machinery.

Secretary Harald Aars, of Den Norske Forleggerforening, Oslo, reported book production, prewar and current, as follows: 1938: of 1,233 titles, 16 technical; 1939: of 1,429 titles, 25 technical; 1945: of 1,437 titles, 26 technical; and 1946: of 1,893 titles, 21 technical. He did not qualify as to the scope of the phrase "technical," and it is assumed that books in the social sciences were not included. He did add that the books included above are only such books as are ordinarily sold through bookstores. Children's picture-books and stencil-printed books are excluded, as are periodicals and their reprints, unless they appear as independent books. He states, on the other hand, that "annals" are included.

CONCLUSION

It is regretted that the inadequacy of the techniques of collecting data with respect to reports on both Denmark and Norway deprives the readers of *Science* of information about the vast and inspiring programs of research and publication which are developing in all the Scandinavian countries. There is in process in both social and physical sciences a new literature which should be of definite interest in America. For example, socialized medicine, on which we in the United States are continuing an important debate, has been a fait accompli in at least two of these countries for a number of years. The results, from the viewpoint of both doctors and patients, would undoubtedly be of great interest to all involved in the American debate.

In this survey of developments in 11 countries, it is significant that the words "research" and "education" appear so regularly. It is my opinion that, in this phase of the world revolution in the social as well as physical sciences, all publishers should utilize all possible agencies, including libraries and book distribution agencies, to accelerate to the best of their ability translations of the best of the important resulting literature. The maximum distribution of translations of important contributions in the sciences as an adjunct to the new programs in education should help to raise the standard of living throughout the world.

Scientific Publishing in Continental Europe:

Notes on Its War and Postwar Status

Charles Harvey Brown, *Associate Director,*
Iowa State College Library, Ames, Iowa

SINCE 1940, MANY AMERICAN SCIENTISTS have been handicapped in their research activities by the lack of definite information concerning the publication and availability in this country of scientific periodicals emanating from Axis and Axis-controlled countries, especially Germany. Some abstracts of articles published in Continental European journals for the war years appeared in *Chemical Abstracts*, *Biological Abstracts*, and other similar journals, but the coverage was far from complete, and often copies of the periodicals abstracted could not be located in the United States. Since scientists in most disciplines have been concerned chiefly with periodical and monographic publications, especially those published in Germany, this article emphasizes such serial publications. The number of scientific and technical journals published in Germany before the war was far larger than that of all other countries of Continental Europe combined.

In 1943 the Library of Congress issued a finding list of journals published in Axis and Axis-controlled countries in 1940–43 which contained many gaps; some periodicals known to have been published were not even listed. For Germany, lists of wartime publications have now become available. Copies of *Halbjahrsverzeichnis* for the years 1941–43, inclusive, were reproduced photographically by J. W. Edwards, Ann Arbor, Michigan, as were copies of *Deutsche Nationalbibliographie* for 1944. These volumes, now obtainable at many libraries, list scientific books and, to some extent, the individual numbers of scientific periodicals published in Germany during the years covered. In 1945, the publication of scientific books and periodicals practically ceased. During the latter part of 1946 and the early months of 1947, some scientific journals resumed publication, and a few new journals were started.

A purchasing mission under the auspices of the Library of Congress, organized in 1946, was able to obtain copies of certain scientific journals published during the war and postwar years. These issues, which are being shipped to a few American libraries assigned priorities by a national committee, will by no means be sufficient in number to satisfy the demand or even to furnish copies to libraries on the priority list. One library with priorities in physics, chemistry, botany, zoology, veterinary medicine, and animal culture has so far received as a result of the Library of Congress Mission only three or four issues of scientific journals published in 1946–47. Nevertheless, the work of the Mission will ensure the availability somewhere in this country of copies of scientific journals which later can be used for photographic reproduction if necessary.

A group of librarians has proposed a project which will indicate the location of all issues of periodicals published in Axis and Axis-controlled countries during the war years. The publication of such a much-needed list may have to await the publication of a second Supplement to the Union List of Serials. Sufficient information to justify the compilation of the list will not be available for many months. In the meantime, the Library of Congress is maintaining a card index showing the location of all copies of war issues of periodicals known to have been received from those countries.

Until the last few weeks, American librarians were unable to place orders for current German publications. In February of this year, the firm of Stechert-Hafner received permission from the Office of Military Government for Germany (U. S.) to send a representative to Germany to arrange for the purchase and shipment of the books and periodicals available there. The first shipments are now en route. It is probable that other American and foreign dealers will soon receive permission to send representatives to Germany to make similar arrangements. In so far as is known at the present time, no dealer except Stechert-Hafner has yet received such permission. Correspondence directly with German dealers and publishers to secure information as to titles, quantities, and prices may be conducted, but financial transactions must be cleared with the U.S.-U.K. Joint Import-Export Agency, Melitta House, Minden, Westphalia, British Zone, and remittances made as directed by that agency and not directly to German dealers. Under the Trading With the Enemy Act, orders involving financial commitments cannot at present be sent directly to any German publisher or dealer.

Some lists of Germany scientific periodicals are becoming available. The latest, compiled in part by Ferdinand Springer, of the firm Julius Springer, appeared in the April 15 issue of Stechert-Hafner's *Book News*[1] and includes the titles of 177 scientific and technical periodicals classified as follows:

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[1] Obtainable from Stechert-Hafner, Inc., 31 East 10th Street, New York City.

Natural Sciences	14
Physical Sciences, including mathematics, physics, chemistry, and pharmacy	24
Medicine and Public Health, including physiology	63
Technology	43
Agriculture and Forestry	10
Economics and Law	23

The list obviously should be revised and supplements published at frequent intervals. Letters from German publishers indicate that plans are now being made for many additions to the list already announced. Springer writes that he expects to resume publication of his many abstracting journals as soon as communications are re-established. Indeed, it is reported that a new volume of *Beilstein's Handbuch der organischen Chemie* is now ready for publication.

The Stechert-Hafner list is probably not complete. A correspondent from Germany mentioned, possibly inaccurately, the revival of *Zeitschrift für Kristallographie*, which is not included. However, a comparison of lists received from German scientists indicates that the Stechert-Hafner list is reasonably complete as of February 1947. In general, it does not contain publications of universities and learned societies, and it seems probable that universities and scientific societies have not yet resumed publication.

An earlier, more general list of periodicals appeared in the German publication, *Kultur-Archiv*, for October-November 1946. *Kultur-Archiv* apparently is a section of *Europa-Archiv*—not to be confused with other publications of a similar name. The "Europa" list, which contains a few titles of agricultural and technical periodicals not included in the Stechert-Hafner list, is of more value to humanists than to scientists.

On the Stechert-Hafner list, over half of the titles represent revivals of earlier periodicals. In some cases, titles have been changed. The *Berichte der deutschen chemischen Gesellschaft*, for example, is now known as *Chemische Berichte*. The extent of the resumption of publication of German scientific and technical periodicals is indicated by a check of the periodicals received by one library before the war with those in the Stechert-Hafner list. Of 409 scientific and technical journals, not including medical, of which issues were received in 1939, only 37 appear on the present list. The list however, contains many old friends, such as *Pflüger's Archiv*, *Liebig's Annalen der Chemie*, *Zeitschrift für analytische Chemie*, *Annalen der Physik*, *Hoppe-Seyler's Zeitschrift für physiologische Chemie*, and *Mathematische Annalen*. Revivals in the pure sciences are few in number compared with those in medicine. Revivals in physiology, which include some outstanding journals, are listed under Medicine in the Stechert-Hafner list. Only one botanical periodical, *Planta*, appears. During the war, medical, agricultural, and industrial periodicals seemed to have been given priority. During the occupation, a very considerable number of periodicals in the field of religion and theology arose, possibly, in part, as a reaction to the strict censorship existing during the Hitler regime.

It is too early to evaluate the content of the German scientific publications of 1946–47. During the Nazi regime, the value. from a scholarly standpoint, of publications in ethnology and the social sciences almost disappeared, although these publications are of some value in indicating ideologies and the mental reactions of the German sociologists and ethnologists remaining in Germany during this period. In the field of the pure sciences, however, many articles in German scientific periodicals published during and after the war are being eagerly requested by scientists and are reported to contain articles of first importance—not, however, on a scale comparable as to quantity or quality to articles published in Germany in earlier years. In many disciplines, the deterioration can be traced back to the first years of the Hitler regime. Evaluation of the periodicals which have recently started publication in Germany is not possible at present, since few, if any, copies are available for examination.

Many current bibliographic publications are now available. The issues of *Deutsche Nationalbibliographie*, published at Leipzig, are a "must" for all American research libraries. Theoretically, this periodical lists all currently-issued German publications, but since it is published in the Russian zone, some German publishers in the western zones may not desire to send as complete information of their publications to Leipzig as formerly. A tendency to separate the publishing activities of the western zones of Germany from those of the Russian zone has developed, possibly because of the different publishing restrictions prevalent in the various zones. The well-known *Börsenblatt für den deutschen Buchhandel*, published in Leipzig, represented before the war the entire book trade of Germany. A new periodical under the same title, published at Frankfurt am Main, in the American zone, represents the book trade of the western zones. In addition, a periodical entitled *Mitteilungen für den Buchhandel in der französischen Zone* is being published in Freiburg, in the French zone, and one with a similar title, published at Munich, represents the book trade of Bavaria in the American zone.[3]

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[3] After this article was in proof, word was received from Germany of the publication in Frankfurt of a periodical entitled *Bibliographie der deutschen Bibliothek*, which duplicates to a considerable extent the material contained in *Deutsche Nationalbibliographie*. Another illustration of the unnecessary duplication of German bibliographic periodicals is the recently announced publication of two periodicals both known as *Chemisches Zentralblatt*, one published in Berlin in the Russian zone, the other in Heidelberg. Both of these periodicals continue the volume number of the original publication.

Committees of the American Chemical Society and the American Library Association are studying the unnecessary duplication of bibliographical periodicals, apparently caused by the rivalry of publishers in the Eastern and Western zones of Germany.

Conditions in Germany are not favorable to scientific publishing. The Armies of Occupation in the various zones have issued rigid, but differing, regulations. Each publisher must acquire a license, which is subject to revocation. The greatest hindrance at present, however, is the lack of paper. One German publisher reports that he has been able to obtain only 10 per cent of the paper stock needed. Furthermore, since Germany is still technically at war, any German scientific publication theoretically may be reproduced photographically in another country and sold at a reduced price. Hence, some manuscripts are being held until assurance is received that copyright will again be enforced.

The prospects for the acquisition of war issues of German scientific books and periodicals are not good. The stocks of many scientific publishers, including those of Julius Springer and Akademische Verlagsgesellschaft, have entirely disappeared. The book trade journals previously listed include many pages of advertisements for wanted publications. The chief hope of American libraries for completion of sets of German war periodicals depends on cooperative plans for photographic reproduction, now being discussed. Even the postwar issues, because of their limited editions, are becoming difficult to obtain. Scientists and librarians who desire any of the periodicals on the Stechert-Hafner list should place their orders immediately. Even now, it is too late to obtain readily issues of some journals published in the fall of 1946.

German publishers, in general, prefer the western zones. Some of them, notably Julius Springer, have established offices in several cities. One publisher writes that he desires to relate his publishing activities to the scholarship and research of the "Western World" scientists and hopes to place his scientific journals on an international basis. Undoubtedly the restrictions on Russian publishing and exports account in part for this point of view. Some consideration is being given to issuing some scientific publications in both the English and, the German languages. In the minor countries of Europe, several periodicals contain more articles in the English language than was the case before the war. The titles and content of some periodicals, more popular than scientific, are of interest as indicating a point of view. The British and American influence is revealed by such titles as *Neues Abendland*, *Neues Vaterland*, *Stimmen der Völker*, *Volkswacht*, and *Zeitwende*.

The war has brought about a shift of many publishing activities from Germany to Austria, Switzerland, Holland, and the United States. New publications have started in these countries which may replace older German serials and monographic works. Publications of such firms as Elsevier Publishing Company (Amsterdam and New York), Academic Press (New York), and S. Karger (Basel) are examples.

In France, scientific publishing never entirely ceased as it did in Germany and, after the liberation, was much more quickly resumed on a prewar basis. Of 93 French scientific periodicals, excluding medical, received by one library before the war, at least 46 are now being published. Of 55 publications of societies and universities, 33 are now being issued. Some of the most notable are the following, well-known to scientists in the various disciplines: Académie des Sciences, *Comptes Rendus*; *Annales de Chimie*; *Archives de Biologie*; *Archives d'Anatomie Microscopique et de Morphologie Expérimentale*; Institut Pasteur, *Bulletin*; *Journal de Chimie Physique*; *Journal de Physique et la Radium*; *Journal de Mathématiques Pures et Appliquées*; and Société de Biologie, *Comptes Rendus*. The subscription prices have been greatly increased, in some cases as much as 8 or 9 times the prewar price. French periodicals which apparently are not being published include such publications as *Annales de Physiologie*; *Matières Grasses*; *Revue de Chimie Industrielle*; and *Revue Générale des Matières Colorantes*.

In proportion to the number of prewar periodicals, France seems to have emphasized somewhat more than has Germany publications in the pure and natural sciences. On the other hand, not so great emphasis seems to have been given by France to publications in technology and medicine. Possibly the need for increased agricultural and industrial production was more keenly felt in Germany.

There is great need for a comprehensive list of current French scientific periodicals as well as a list of discontinued titles, with volume and number of the last issue published. Any dealer except an enemy alien can arrange for importation of books from France and other European countries, with the exception of Germany.

Italy, as was to be expected, has been slow in the resumption of publishing activities. With the exception of publications of institutions, few periodicals in the pure and natural sciences published before the war have reappeared. Among the casualties are the well-known publications of the Naples Zoological Station, *Rendiconti* of the Circolo Matematico di Palermo, *Bolletino* and *Memorie* of the Società Entomologica Italiana; and *Clinica Veterinaria*. The list could be greatly extended. On the other hand, *Annali di Chimica Applicata*; *Annali di Matematica*; *Annali d'Igiene*; *Archivio di Fisiologia*; *Bollettino* of the Istituto Sieroterapico Milanese, *Bollettino* of the Unione Matematica Italiana; *Giornale degli Economisti*; *Rivista di Biologia*; *Scientia*; and *Bollettino* of the Societa Italiana di Biologia Sperimentale have been resumed. Unconfirmed reports have been received of the resumption of publication of the highly-esteemed *Memorie* of the Reale Accademia dei Lincei.

Appeals are being received daily from Italian academies, universities, and experiment stations for a resumption of exchanges with American institutions. Most of these letters bemoan the fact that, unfortunately, the would-be recipients although hopeful of resumption of Italian publications at some future date, have nothing at present to offer in exchange. Most of the universities in Italy, as well as in many other countries, have received no American publications for the last five or six years and are naturally eager to obtain foreign scientific publications issued during that period. Because of financial conditions, purchases are not possible. Shipments by the American Library Association and the American Book Center have necessarily been limited chiefly to allied and neutral devastated countries.

A majority of Austrian scientific periodicals have now resumed publication, but these never compared in number with those issued in Germany or France. Lists from such dealers as Urban and Schwarzenberg and Springer Verlag, in Vienna, are obtainable from any American importer. It is reported that some periodicals formerly published in Germany are now published in Vienna. Not many such cases could be found, with the exception of periodicals published by firms with offices in both countries. Some periodicals, such as *Mikrochemie*, formerly issued by Springer in Berlin, are now being issued by Springer in Vienna. Among the typical Austrian periodicals which can be obtained through any dealer except an enemy alien are: *Monatshefte für Chemie*, *Wiener botanische Zeitschrift* (formerly *Oesterreichische botanische Zeitschrift*), *Wiener klinische Wochenschrift*, and *Wiener tierärztliche Monatsschrift*.

A number of new journals have started publication in Austria, chiefly in Vienna, but these are concerned more with industry and building than with the sciences. *Oesterreichische Bibliographie*, now available at many libraries and from any importer, lists periodicals, but cites titles of periodicals in lists of books under subject classification. Such citations are not convenient for checking by American libraries for ordering purposes. The compilation of lists of scientific periodicals now being published in Austria is desirable. The revival of publication in Austria, as in Germany, seems to be much more extensive in the field of the humanities and in medicine than in the sciences.

The Viennese book trade journal, entitled *Anzeiger für den Buch-, Kunst- und Musikalienhandel*, is of value to librarians and scholars interested in Austrian publications, partly for the information it gives concerning publishing activities. Advertisements of Swiss, British, and American books appear. One dealer lists for sale *Benjamin Franklin*, *Yankee from Olympus*, and *George Washington Carver*. Another advertises that he has just received copies of the journal *Britain today*. If the *Anzeiger* represents accurately the thinking of the Viennese, Austria, or at least Vienna, is also looking toward the West for the resumption of its cultural relations.

Reports from Russia are most discouraging and, in some cases, conflicting. Many Russian periodicals cannot be exported. A list entitled *1947 Periodica U S S R*, obtainable from any importer, contains the titles of 202 periodicals, chiefly scientific, which are available for export. Reports indicate that the Russian Government may forbid at any time the export of single issues of any periodical. It is therefore difficult, if not impossible, for a library to obtain complete volumes of any Russian serial, although in some cases the missing issues may have been obtained through personal channels. Some scientists have reported that, through personal correspondence with their colleagues in Russia, they have been able to obtain numbers of periodicals not available for export. Institutions having publications to offer on exchange have found that Russian academies and societies have been liberal in exchanging their publications.

Even less information with regard to scientific publications can be obtained from the Russian satellite countries than is available from Russia. Probably the most valuable scientific publications received before the war from Poland, Rumania, and Bulgaria were issued by universities and learned societies. At present not much is known definitely of the revival of any of these publications. The little information which has been received came as a result of personal correspondence. Requests for information on the availability of scientific periodicals in the Russian satellite countries have not met with entirely satisfactory responses. Undoubtedly, more information will be available within the next year or two. Especially in the case of both Russia and her satellite countries, the chief hope seems to lie in the eagerness of institutions and societies in these countries to receive American publications on exchange. This fact has much significance, not only for the acquisition of their scientific publications but also as a means of developing cultural relations with countries with which international understandings are most desirable.

Letters have been received from Czechoslovakia requesting exchanges, but few Czechoslovakian publications seem to be available for such purposes. It seems probable that scientific periodicals have not been revived or started to any considerable extent. One noted exception, however, is the valued *Collection des Travaux Chimiques de Tchecoslovaquie*, which ceased publication in December 1939 and resumed in 1947. The volume numbers indicate that no issues were published for the 7 intervening years.

Note should be made of the great increase in the publication of scientific books in Switzerland. The transfer of German periodical publication from Germany to Switzerland, anticipated by so many, apparently has not taken place, but several anti-Nazi scientists who formerly contributed to German medical periodicals are now found as contributors to similar Swiss publications.

Scandinavian, Belgian, and Dutch publications are rapidly returning to the prewar basis. Many of the scientific publications never suspended publication, although issues were somewhat irregular. Libraries quite generally are now able to obtain complete files of the scientific and technical journals received before the war.

As Continental Europe recovers from the war, and as more paper stock becomes available, scientific publishing should be resumed on a greatly increased scale. Avenues of communications are now being opened. The development of exchanges of scientific publications is most desirable; closer relations between American scientists and those of foreign countries will make the international exchange of scientific information more widespread than would be possible if the exchanges were on an entirely commercial basis. American scientists, together with our academic institutions, can contribute much to the future peace of the world.

NEWS *and Notes*

On July 15 the steel ketch *Atlantis* sailed from Woods Hole, Massachusetts, its destination being the mid-Atlantic Ridge, some 1,200 miles east of Bermuda. On board were Maurice Ewing, of Columbia University, and a corps of assistants, who will survey the topography of the Ridge and attempt to discover the character of its rock and the nature and depth of its sedimentary covering. From the data accumulated by the expedition, which is sponsored by the National Geographic Society, Columbia University, and the Woods Hole Oceanographic Institution, these scientists hope to ascertain how and when the Ridge was formed.

The Ridge, with peaks rising over two miles above the ocean floor, stretches from Iceland almost to Antarctica. The depth of the portion under survey will be measured by echo-sounding—recording the time required for a sound wave produced at the ship to travel to the ocean floor and back, and utilizing the velocity of sound in water to calculate the distance to the bottom. In addition, cross sections of sediment will be collected by means of 10-foot-long steel tubes equipped with 850-pound lead weights, which will be dropped over the side. By this means the ages of the various layers may be determined and changes in the earth's magnetic field may be shown. But these cores will sample only the most recent portion of the sediment. To determine the entire thickness sonic measurements will be used. Still another interesting piece of equipment is the Nansen bottle, which, when lowered, fills with water at any desired depth, water from other levels being kept out by a series of valves. These bottles enable the study of microscopic life and salinity far below the surface. A special undersea camera perfected by Prof. Ewing and his students will also be used.

Reservations are available for several of the Chemical Research Conferences sponsored by the AAAS and being held this summer at Colby Junior College, New London, New Hampshire. Increase in facilities at the College has permitted a larger attendance than in previous years at Gibson Island.

Conferences for which reservations are available are: Medicinal Chemistry, July 21–25; Vitamins, July 28–31; Food and Nutrition, August 4–8; Cancer, August 11–15; and Instrumentation, August 18–22. Requests for attendance should be addressed to W. George Parks, Colby Junior College, New London, New Hampshire.

The final program for the Conferences was published in the May 2 issue of *Science*.

A National Science Foundation bill, H.R. 4102, introduced into the house by Rep. Wolverton of New Jersey on July 7 and reported out by the Committee on Interstate and Foreign Commerce, is scheduled for debate on the floor as *Science* goes to press. This bill, although carrying essentially the same provision as S. 526, stipulates that the director shall be appointed by the Foundation of 24 members instead of being appointed by the President after consultation with the Foundation and approval by the Senate (see *Science* May 30). The bill omits specific mention of the social sciences and allotment of research funds to states. It authorizes establishment of special commissions on cancer research, heart and intravascular diseases, poliomyelitis, and such others as deemed necessary. Its patent provision prohibits individuals from obtaining patents for any invention resulting from their activities with the Foundation. Such individuals may, however, apply for patents to be assigned to the government or its nominee.

About People

E. A. Vuilleumier has resigned as dean of Dickinson College, Carlisle, Pennsylvania, in order to devote full time to his professorship of chemistry. Dr. Vuilleumier, who has been head of the Department of Chemistry since 1920 and dean since 1933, will be succeeded by **Russell I. Thompson** as dean.

Lorus J. Milne, who since 1942 has been working in the field of aviation medicine at the Johnson Research Foundation, University of Pennsylvania, has been appointed associate professor of zoology at the University of Vermont, effective in August.

J. H. Quastel, British scientist known for his work in enzyme chemistry, has been appointed professor of biochemistry at McGill University and associate director of the Montreal General Hospital Institute for Special Research and Cell Metabolism. Dr. Quastel will also serve as director of the enzyme research division of the Institute.

George W. Snedecor, director, Iowa State College Statistical Laboratory, since its establishment in 1933, and a member of the mathematics staff since 1913, retired from administrative duties July 1 but will continue as professor of statistics and as consultant to the Laboratory.

Grants and Awards

Iowa State College has been given a grant of $300 from the China Foundation for reproduction of scientific articles for Chinese scholars, who have received almost no scientific publications from western countries since the beginning of the war. The Iowa State Library will direct the work of reproduction.

At the annual dinner of the American Institute of Nutrition, May 19, in Chicago, the Borden Award for 1947 was presented to **L. A. Maynard,** director, School of Nutrition, New York State College of Agriculture, Cornell University, for his significant contributions, both to the field of general nutrition and to the knowledge of the physiology of milk secretion, of factors affecting milk production and milk composition, and of the requirements of animals for dietary fats. The Mead Johnson and Company Award for Research on the Vitamin B Complex was given to **William J. Darby,** associate professor of biochemistry, Vanderbilt University School of Medicine, **Paul L. Day,** professor of physiological chemistry, University of Arkansas School of Medicine, and **E. L. R. Stokstad,** research chemist, Lederle Laboratories, for their discoveries and investigations in the field of the B-complex vitamins with special reference to their studies on the chemical nature and nutritional significance of folic acid.

At the 37th annual meeting of the American Society for Pharmacology and Experimental Therapeutics, held May 18–22 in Chicago, the John J. Abel Prize in Pharmacology was awarded to **George Sayers,** assistant professor of pharmacology, School of Medicine, University of Utah, in recognition of his paper, "The Pituitary-Adrenal System." The prize, of $1,000 and a bronze medal, plus traveling expenses up to $150, is awarded to a young man or woman working in a college or university by Eli Lilly and Company, for the purpose of stimulating fundamental research in pharmacology in the United States and Canada.

The Order of the White Lion was awarded to 17 Americans, June 3, in recognition of their services to Czechoslovakia last year. The awards were presented by Dr. **Juraj Slavik,** Czechoslovak Ambassador to the United States, on behalf of his Government, to the following members of the Unitarian Service Committee Medical Teaching Mission: Paul Dudley White, Harvard Medical School; Alexander Brunschwig, Cornell University College of Medicine; Ralph Waldo Gerard, University of Chicago; Emery A. Rovenstine, New York University College of Medicine; L. Emmett Holt, Jr., New York University College of Medicine; Leo M. Davidoff, Columbia Medical School; Colin Munro MacLeod, New York University College of Medicine; James E. M. Thompson, president, American Academy of Orthopaedic Surgeons; Joseph Charles Aub, Harvard Medical School; Joseph Francis Volker, Tufts College Dental School; Otto Krayer, Harvard Medical School; Joseph Peter Lazansky, Tufts College Dental School; Milan Alexander Logan, University of Cincinnati College of Medicine; Everett Dudley Plass, University of Iowa Medical School; Kenneth D. Miller, president, New York City Mission Society; and Mr. and Mrs. Waitstill H. Sharp, Boston.

The Heyman Prize, awarded every three years and alternating between literature and science, has this year been awarded to Docent **Börje Kullenberg** by the Götegorgs Högskola, in recognition of his distinguished work in constructing the piston core-sampler, which affords means for a new departure in submarine geology. The sampler was used very successfully during the *Skagerak* expedition to the western Mediterranean in the spring of 1946 and will be utilized also in the forthcoming Swedish deep-sea expedition with the *Albatross.* In 1941 the first science award was divided between Helge Backlund and Lennart von Post, eminent geologists.

Colleges and Universities

The Agricultural and Mechanical College of Texas has established a Department of Biochemistry and Nutrition which will include work and staff members that have previously been in three different departments. Paul B. Pearson, of the Nutrition Laboratory, has been named head of the new department, which will become effective September 1.

New York University and Stevens Institute of Technology will jointly sponsor a new fluid dynamics program, to be opened in September. The course in fluid dynamics of aircraft, ships, and related bodies, inaugurated by the Graduate School of Stevens and the Graduate Division of the College of Engineering, New York University, will make possible a combination of theory and experimentation through the use of the wind tunnels at the Daniel Guggenheim School of Aeronautics and the towing tanks of Stevens.

Coordinated courses in mathematical methods, theoretical and applied hydro- and aerodynamics, experimental methods, and high-velocity gas dynamics will lead to a Master's degree. Enrollment in the course is limited for the first year to 15 students, chosen by the two colleges on the basis of the student's individual record.

The Institutum Divi Thomae, Cincinnati, Ohio, founded in 1935 as a graduate research school open to all scientists regardless of race, color, or creed, has recently received from the Donner Foundation, Inc., a $150,000, 64-room building located in Palm Beach, Florida. The building, to be known as Donner Hall, will provide quarters for what is planned to be the largest marine biophysics laboratory in the world, for fundamental cancer research, and for visiting scientists who will be participating in various symposia.

At the 75th anniversary commencement of the University of Arkansas on June 9 **Lewis Webster** Jones, formerly president of Bennington College, was inaugurated president. Among those receiving the LL.D. degree was A. F. Blakeslee, of Smith College.

Summer Programs

The Maxwell Graduate School of Syracuse University has announced that during this summer it is sponsoring the Social Science Field Laboratory, conducted for over 10 years at Ukiah, California, by B. W. Aginsky, chairman, Department of Sociology and Anthropology, College of the City of New York, and Ethel Aginsky, Department of Anthropology, Hunter College. The program, sponsored by New York University from 1938 to 1941, was suspended during the war. The full program, now resumed, includes special research training for eight selected advanced students from several universities. Although originally focused on the anthropological study of the Pomo Indians, it has now been broadened to include studies of the entire community of Ukiah and neighborhood, involving coordination and integration of all of the various social sciences. Its new official name is The Social Science Field Laboratory Institute Under the Auspices of the Maxwell Graduate School of Citizenship and Public Affairs. The director is B. W. Aginsky; the associate director, Ethel Aginsky; and the assistant director, Alfred P. Parsell, who teaches sociology at Hunter College.

Industrial Laboratories

Sharp & Dohme, Inc., announces that Karl H. Beyer, director of pharmacological research, Medical Research Division, sailed for England July 11 for a meeting with Sir Alexander Fleming, discoverer of penicillin, to discuss "Staticin" Caronamide, his own discovery, and to attend the International Physiological Congress, Oxford University, July 21-25, where he has been invited to speak. Dr. Beyer also plans to attend the British Pharmacological Society Meeting, University of London, July 26.

Smith, Kline & French Laboratories have announced the association of Ivan H. Witt with the Organic Chemistry Section of their Research Department. Dr. Witt was formerly associated with the B. F. Goodrich Company.

G. H. A. Clowes, director emeritus, Lilly Research Laboratories, was honored by the American Diabetes Association at its annual meeting, June 7-8, at Atlantic City, New Jersey. Dr. Clowes delivered the annual Banting Memorial Address and was awarded the Banting Medal, given in recognition of distinguished service in the field of diabetes.

Eastman Kodak Company has offered to 16 educational institutions 22 fellowships in chemistry, physics, engineering, and business administration for the 1947-48 school year. The fellowships, established in 1939 to enable outstanding young scientists to do advanced work in scientific and engineering fields, have been offered each year except 1944-45. Of the 12 fellowships for doctoral work ($1,200 each), one in physics and one in chemical engineering will go to Massachusetts Institute of Technology; one each in physical chemistry to Columbia, Rochester, and Yale Universities; to Harvard, Illinois, Nebraska, and Notre Dame Universities, in organic chemistry; to California Institute of Technology and the Universities of Michigan and Wisconsin, in physics. Ten fellowships for master's work, each of $750, have been offered to Columbia, Michigan, Illinois, and Northwestern Universities (business administration); Carnegie Institute of Technology and Iowa State (mechanical engineering); Cornell University and Rensselaer Polytechnic Institute (electrical engineering); Cornell University and University of Michigan (chemical engineering). Six Tennessee Eastman awards include four at $1,200 for doctoral work in chemistry at Brown University and the Universities of Tennessee, North Carolina, and Virginia, and two for master's work ($750 each) in chemical engineering at Virginia Polytechnic Institute and in textile engineering at Georgia School of Technology. Selection of students is made by the recipient institution.

Meetings

The Purdue Section, American Society of Plant Physiologists, has announced that E. J. Lund, author of the recent *Bioelectric fields and growth,* will give a series of three lectures and additional round-table discussions on "Bioelectric Phenomena and Cell Correlations" at its summer meetings, which will begin with registration on the morning of July 24 and conclude with a botanical field trip through Turkey Run State Park, Friday afternoon, July 25. All those interested are invited to attend. Reservations and additional information may be secured from H. H. Kramer, Agronomy Department, Purdue University, Lafayette, Indiana.

The Australian and New Zealand Association for the Advancement of Science will hold its 26th meeting in Perth, August 20-27.

The 8th International Congress of Entomology will be held in Stockholm, Sweden, August 8-15, 1948. It is necessary that those planning to attend arrange for steamship passage early this fall, since sailings are currently booked to capacity for months in advance. It is understood that the 13th International Congress of Zoology will be held in Paris in July 1948, and it is hoped that all entomologists going to Stockholm will plan to attend the Zoological Congress in order that the interests of the entomologists may be fully represented before the more comprehensive body. Those expecting to attend the Stockholm Congress should contact Prof. O. A. Johannsen, Comstock Hall, Cornell University, Ithaca, New York, as early as possible.

The American Association of Petroleum Geologists will hold its 33rd annual meeting in Denver, Colorado, April 26-29, 1948. The Rocky Mountain Association of Geologists will be the host for this occasion, and it is planned that the annual meetings of the Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists will be held in Denver at the same time. T. S. Harrison and A. E. Brainerd, both consulting geologists of Denver, are in charge of arrangements.

Elections

At the Annual Election Meeting of the Czechoslovak Academy of Agriculture, May 7, 1947, several Czechoslovak and foreign agricultural scientists were elected to honorary membership. This is considered the highest distinction for services or scientific work in agriculture. The maximum number of living honorary members is limited to 40. Those elected include: H. C. Josef Opletal, professor, Agricultural College, Brno, Czechoslovakia; Edwin R. Henson, director, Agricultural Rehabilitation Division, UNRRA, Washington, D. C.; Nikolaj Vasilijevic Cicin, director, Plant Breeding Institute, Moscow; Trofim Denisov Lysenko, director, Lenin Academy of Agriculture, Moscow; Sir John Boyd Orr, director general, FAO, Warden Hill, Scotland; and Herbert C. Hanson, chief, Agricultural Division, UNRRA Mission, Prague, Czechoslovakia.

Elected as corresponding members, the limit of which is 120 foreign workers, were: C. G. Vilenskij, professor of pedology, University of Moscow; Hans Pallman, professor of agrochemistry, Technical University, Zürich, Switzerland; Kyril Pavlov, chief, Selection Department, State Research Institute, Sofia, Bulgaria; Nikolaj Belcen Kolev, director, Plant Selection Institute, Sofia, Bulgaria; John Hammond, professor, animal physiology, Cambridge University, Cambridge, England; and Dimitr Bailov, professor and director, Tobacco Growing Institute, Agricultural-Forestry Faculty, Plovdiv, Bulgaria.

K. Kavina, professor of botany, University of Prague, is president of the Academy, and F. Duchon, secretary. The Academy issues the following journals: *Vestnik CAZ* (Journal of the Czechoslovak Academy of Agriculture) with *Ceska Zemedelska Bibliografie* (Bibliography of Czech Agriculture); and *Sbornik CAZ* (Almanac of the Czechoslovak Academy of Agriculture).

The University of Oregon Chapter of Sigma Xi has recently elected the following officers for the coming year: Lloyd W. Staples, Department of Geology, president; John M. Pierson, University of Oregon Medical School, vice-president; E. Ebbighausen, Department of Physics, secretary; and K. S. Ghent, Department of Mathematics, treasurer.

The Minnesota Academy of Science, at its 15th annual meeting held at State Teachers College, Mankato, April 26, elected Walter J. Breckenridge, director, Museum of Natural History, University of Minnesota, president; Duncan Stewart, Carleton College, Northfield, vice-president; W. C. Croxton, State Teachers College, Saint Cloud, councilor, 1947-51; and John W. Moore, University of Minnesota, secretary-treasurer, for a four-year term. George J. Miller, State Teachers College, Mankato, retiring president, became a two-year member of the Council, and Robert C. Molkenbur, Central High School, St. Paul, newly elected president of the Minnesota Junior Academy of Science, is a member, ex officio, of the Senior Council for the year.

NRC News

A Committee on UNESCO has been formed to facilitate the participation of scientists in the program of the United Nations Educational, Scientific, and Cultural Organization. The present membership includes Detlev W. Bronk, chairman, National Research Council; R. E. Cleland, University of Indiana; William Higinbotham, Federation of American Scientists; J. S. Nicholas, Yale University; Merle A. Tuve, Carnegie Institution of Washington; Maurice B. Visscher, University of Minnesota; Gene Weltfish, Columbia University; Dael Wolfle, American Psychological Association; and Raymund L. Zwemer, National Academy of Sciences and National Research Council. Bart J. Bok, Harvard University is chairman of the Committee.

The Committee proposes to act as a clearinghouse for suggestions about UNESCO activities submitted by American scientists; to urge full participation by American scientists in the affairs of UNESCO and to give wide publicity to the activities of UNESCO, especially in the field of the Natural Sciences; to promote exchanges of scientists under the auspices of UNESCO; and, when requested, to assist the Natural Sciences Division in Paris, the Field Science Cooperation Offices, and members of the U.S. National Commission of UNESCO.

Recent Deaths

Ralph A. Jacobson, 51, research chemist, Chemical Department, E. I du Pont de Nemours and Company, died July 2 after a short illness.

William Carl Ruediger, 73, dean emeritus, School of Education, George Washington University, and former provost, died at his home in Washington, D.C., on July 4.

Warren B. Davis, 65, clinical professor of plastic and reconstructive surgery, Jefferson Medical College, and surgeon, Jefferson Hospital, died July 7 at his home in Overbrook, Pennsylvania, after a long illness.

Mark Heiman, 71, dermatologist and syphilologist, St. Joseph's Hospital, Syracuse, New York, and former president, American Academy of Dermatology, died July 2 at his home in Syracuse.

S. F. Light, 61, professor of zoology at the University of California since 1929, died in Berkeley, California, June 21. Dr. Light is co-author of two articles on termites, to appear in *Science* in the near future.

An Indian Phytopathological Society was established by mycologists and plant pathologists meeting at the Indian Agricultural Research Institute, New Delhi, February 28, 1947. Membership is open to all individuals and groups interested in the study of fungi, bacteria, viruses, and their useful and harmful aspects. Those joining before January 10, 1948 will be designated as Charter Members. Communications should be addressed to: B. B Mundkur, Secretary-Treasurer, Indian Phytopathological Society, Agricultural Research Institute P. O., New Delhi, India.

A two- to three-month stay in Sweden is in store for about 120 scientists and teachers from European war-devastated countries, according to a recent report from the American-Swedish News Exchange, Inc. Costs of their stay are to be paid by the Swedish Government. Although most of the visitors will arrive in September, at the beginning of the university term, opportunity is afforded those who wish to attend scientific congresses to be held in Sweden this summer to do so. Although many different branches of science are represented, the majority are medical men and technologists.

The South African Council for Scientific and Industrial Research, set up in October 1945 as "a corporate body responsible to the Prime Minister for the formulation and the implementing of a national policy of scientific and industrial research," has organized Liaison Offices in both England and the United States. Inquiries from the respective countries relating to work being done in South Africa should be addressed to: Head: South African Scientific Liaison Office, 39 Princes Gate, Exhibition Road, London S. W. 7, or 1785 Massachusetts Avenue, Washington 6, D. C.

Make Plans for—

Conference on Algebra, July 25–28, University of Michigan, Ann Arbor.

New England Association of Chemistry Teachers, 9th Summer Conference, August 18–23, Wellesley College, Wellesley, Massachusetts.

Annual Symposium, Society for the Study of Development and Growth, August 26–29, University of Connecticut, Storrs.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS
by Readers

In a recently published article by Rake, Alexander, and Hamre (*Science*, October 26, 1945), the following statement was made: "It would seem most probable that the agent of heart-water fever, while not distinctly either a Rickettsia or a member of the lymphogranuloma-psittacosis group, is related to both."

In a tentative classification of the cytotropic viruses of the *Chlamydozoa-Rickettsiae* group (*Adv. mod. Biol.*, 1945, **19**, 1–44), I have indicated that the causative agent of heart-water fever differs from the classical *Rickettsiae* and agrees with the organisms of the family *Ehrlichiaceae* in its dimensions, in sensibility toward the action of the sulfonamide drugs, and especially in its aptitude to provoke the formation of vacuoles in the host cell, including the aggregated elementary bodies representing the parasite.

The subgeneric name *Cowdria* (in honor of Edmund V. Cowdry) was therefore proposed for this organism, and the necessity of separating it from the genus *Rickettsia* was taken into consideration.

I can thus fully agree with the authors of the above-mentioned article on the close parentage between the causative organism of heart-water fever and the members of the lymphogranuloma-psittacosis group belonging, according to the named classification, to the subgenus *Ehrlichia* (*Myiagawanella*).

The striking resemblance between the agent of heart-water fever and *Ehrlichia kurlovi* as to the dimensions of the single elementary bodies, the production of vesicles in the affected cell, and the tendency to assume a bacilliform appearance is clearly visible in the illustrations of my article (*Adv. mod. Biol.*). During Dr. R. Weigl's visit to Moscow, I was able to show him preparations of *E. kurlovi* which were indistinguishable from *R. ruminantium*.

On the other hand, the agent of heart-water differs from the members of the genus *Ehrlichia*, including the subgenus *Ehrlichia* (*Myiagawanella*), in its histotropism and the mode of propagation. Its antigenic differences have also been recently established (*Science*, October 26, 1945).

On these grounds we propose to raise the subgenus *Cowdria* to the rank of a genus, intermediate between the families *Rickettsiaceae* and *Ehrlichiaceae*, having in common with the first the tropism to the cells of vascular endothelium and sharing with the second the localization inside vacuoles formed in the cytoplasm of the host cell. The specific name of the agent of heart-water fever will then be *Cowdria ruminantium* nom. nov., and the diagnosis of the genus *Cowdria*: cytotropic organism, coccoid with a tendency toward formation of bacillar forms; characteristic localization in the form of clusters inside vacuoles in the cytoplasm of vascular endothelium. (Sh. D. Moshkovski, *Institute of Malaria and Medical Parasitology, Moscow, USSR.*)

Any fungus that causes decay of heartwood is a pathogen. This thesis is an incident of my interest in the problem of competition between sprouts and seedlings in the forest. It is my view on decay as one of the factors in the decadence of coppice. The entire causal basis of the superiority of seedlings over sprouts is probably within the realm of developmental anatomy (private publication of author, February 1947, on "The nature of the seedling and sprout growth forms").

A large volume of literature on the subject of developmental anatomy has appeared in recent years. Bailey, Chalk, Cockerham, Elliot, Priestley, and others have probed into the subject. Their work on the stele and their studies on the influences of environmental factors on developmental anatomy have enriched the field of botany and given us useful tools of knowledge. My own studies on the effects of temperature and rainfall indicate that the speed and the degree of differentiation of tissues can be influenced by external factors ("Studies on breakage of apple trees," unpublished, Pennsylvania State College, 1936).

The entire subject of meristems, development, and behavior is in a state of flux. The complex pattern of interwoven threads of the origin, organization, form, mass, and location of a meristem, in relation to the appearance of axes, leaves, and blossoms, the form and size of organs, and the organization and extent of primary and secondary tissues, is slowly becoming apparent. It is obvious, however, that the locations, kinds, and human uses of initials are still problems and not findings. Discoveries are largely in the realm of the future (*Science*, October 4, 1946, p. 329; *Bull. Torrey. bot. Club*, 1936, **63**, 259–265).

With regard to the thesis posed above, heartrot is more likely an indirect rather than a direct cause of failure in coppice. Though a tree may be broken by the wind, or may fall of its own weight after heartrot has spread in the bole, a tree so weakened has lost its competitive power before the mechanical defects are obvious. From the time it appears in the wood, heartrot will interfere in a cumulative manner with normal development, through retardation of the developmental processes, with consequent reductions and changes in the amounts and types of tissues that form. By reducing the capacity of heartwood to act as a water reservoir, especially during the latter part of the growing season, the progressive spread of decay will interfere with the production of, and differentiation in, tissues and therefore with the movement of water and the translocation of solutes. Such interference with movement, through retardation of transportation capacity, will influence adversely the developmental anatomy of the plant. Given such a situation, any fungus that causes heartrot is a pathogen. (Isador Aaron, *P. J. Oesterling & Son, Inc., Butler, Pennsylvania.*)

The word *nuclide*, derived from *nucle-* (nuclear) and *εἶδος* (species), is defined as "a species of atom characterized by the constitution of its nucleus." It is proposed that this term be used for the concept in question in place of such incorrect or inconvenient expressions as *isotope*, *nucleus*, *atomic species*, and *nuclear species*. A more detailed discussion is being published in the *American Journal of Physics*, July–August 1947, **15**. (Truman P. Kohman, *Institute for Nuclear Studies, University of Chicago.*)

TECHNICAL PAPERS

Influence of Dithiopropanol (BAL) on Human Lead Metabolism

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Barron and Kalnitsky (*2*) have shown that certain heavy metals, including lead, may produce complete inhibition of the sulfhydryl-containing enzyme, succinoxidase, and that the enzyme is reactivated on the addition of certain dithiopropanol (BAL) derivatives. This is the type of evidence that has been accumulating in support of the hypothesis that heavy metals are toxic to biological systems because of their reversible combination with the sulfhydryl groups of the protein fraction of cellular enzymes (*4*). The value of dithiopropanol in the treatment of rabbits poisoned by single and multiple intraperitoneal inoculations of lead nitrate has been examined by Braun, Lusky, and Calvery (*3*). Their experimental findings were regarded by themselves as evidence that lead and dithiopropanol exert additive toxic effects in both acute and chronic types of poisoning due to lead.

We have studied the effect of one intramuscular dose of dithiopropanol (5 mg./kg. of body weight) upon the concentrations of lead in the blood and urine of each of a series of men whose occupations, at the time of the observations and for some time previously, involved no exposure to lead or varying degrees of severity of exposure. Some of these men were suffering from lead poisoning, and others were not. The observations were carried out, repeatedly, upon a number of the men. Samples of blood and urine were analyzed for lead by a dithizone method (*1*) of known sensitivity and precision.

The concentration of lead in the whole blood decreases promptly and considerably following the administration of this agent (Table 1). The initial rate of decrease is extremely rapid, a sizable change being demonstrable within 7½ minutes and, judging from the apparent hyperbolic relationship of the early values, being well under way even earlier. The fall appears to reach its maximum within 8 hours; it is relatively greater, but absolutely less, the lower the initial concentration of lead in the blood. The concentration in the blood returns to approximately the previous level within 24-48 hours. This entire series of effects can be obtained again and again by repetitive administration of the agent.

The concentration of lead in the urine has been found to be moderately or greatly enhanced by the administration of dithiopropanol (Table 1). The urinary concentration of lead reaches its peak within an hour or two following the injection and diminishes rapidly to the previous level in from 8 to 24 hours. In those cases in which the increase in the concentration of lead in the urine was of only moderate proportions, the analysis of blood samples, drawn at the end of the functional periods represented by the samples of urine, demonstrated that the usual response to the administration of dithiopropanol had occurred therein, and the usual symptomatic effects, if any, of the agent were observed.

The concentration of lead in the blood plasma of these men was found to be independent of the cellular concentration of lead and was also unrelated to signs or symptoms of lead intoxication. It appeared to be unaffected by the administration of the agent (Table 1). The samples of plasma, which averaged 25 grams in weight, were obtained by the prompt centrifugation of whole blood drawn into a dry syringe and heparinized. The observations on the concentration of lead in the plasma cover the extremes in the range of cellular concentration of lead. These results indicate that relatively large quantities of lead released from the erythrocytes do not remain within the blood stream, but are lost with great rapidity, to appear, presumably, in the tissues generally as well

TABLE 1

Concentration of Lead (µg./100 Grams) Following Intramuscular Administration of Dithiopropanol (BAL)

Subject	Date	Before BAL			Seven minutes after BAL			One hour after BAL		
		Cells	Plasma	Urine	Cells	Plasma	Urine	Cells	Plasma	Urine
C. F.	12-31*			2						160
	2-3	70	9	3	40	6		28†	7†	9†
W. E.	12-25*			2						35
	2-10	65	9	1				40	12	48
E. G.	12-10‡	200	9	16				130	9	250
	12-27	145	5	9						380
N. B.	1-30‡	340	5	75	290	8				1,760§
	2-10	240	6	24	200	10				320§
A. E.	1-31‡			17						620
	2-11	315	8	11	230	14				430
O. C.	1-31‡			18						51
	2-17			36						1,310§
J. H.	3-25‖	1,250	6	11	1,250	6				23
	3-28	1,100	3	14	1,200	3		1,050	3	113§

* Case of poisoning with bichloride of mercury.

† Samples taken ½ hour after administration of BAL.

‡ Subject suffering from lead colic on this date, but not on that of later observation.

§ Samples taken 2 hours after administration of BAL.

‖ Subject not suffering from lead colic on either occasion. He was given 1.8 mg. of dithiopropanol/kg. of body weight on each occasion; the other men were given 5.0 mg./kg.

as in the urine. They also suggest that a great proportion of the lead remaining in the plasma is bound to some constituent or radical that is fully saturated thereby, even when the lead concentration in the whole blood does not exceed the normal limits. These facts and considerations may well explain our inability at any time to confirm the reports of Smith, Rathmell, and Marcil (*5*), to the effect that the lead concentration in the plasma is elevated in human lead intoxication.

The interest that attaches to any agent that can produce such remarkable metabolic effects as those described above is naturally great. By carefully designed metabolic experiments, we have been unable to discover evidence of the ability of any other therapeutic agent or combination of agents to influence materially the pattern of lead metabolism in the human organism. The administration of acids, alkaline salts, and iodides, as well as experimentally induced changes in the calcium and phosphorus metabolism, has failed utterly in our hands to bring about more than the most dubious and insignificant alterations in the lead content of the blood or in the rate of excretion of lead on the part of normal individuals or of persons with considerably increased quantities of lead in their tissues and excreta. Indeed, we have found no effect which could not be brought about more strikingly and more persistently by altering the rate of water intake of the patient or subject under study.

Thus, the effects of the administration of dithiopropanol are unique in our experience and are of potentially great physiological importance. However, their significance at this time should not lightly be credited to the field of therapy, since the intensity and brevity of the single response is such that no quantitatively important proportion of the absorbed lead of a poisoned or endangered individual has been removed thereby from the body.

We also wish to emphasize that dithiopropanol is potentially a dangerous drug, and that lead intoxication is largely a self-limited disease for which the only primary treatment of proved value is the removal of affected men from further exposure to lead. We have been unable consistently to shorten the clinical course of lead intoxication, to maintain a significantly increased rate of elimination of lead, or to decrease the duration of the occupational disability of affected men, by repeated doses of the drug, because of the induction of hypertension, annoying local or generalized immediate reactions, or delayed generalized muscular aching. In addition, our observations suggest that the drug may have relatively less effect, the greater the concentration of lead in the body fluids. This phenomenon is analogous to the observations of Barron and Kalnitsky on the disproportionate reduction of the effectiveness of dithiols following increases in concentration of the heavy metal inhibiting preparations of succinoxidase.

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The Ultraviolet Absorption Spectrum of Cerebrospinal Fluid: Ascorbic Versus Nucleic Acid

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A recent report (*8*) on the origin of an enzyme in cerebrospinal fluid (CSF) which produces a chromatolytic effect following cerebral concussion has been predicated upon spectrophotometric data based upon two assumptions which, according to our experiments, are not valid. These two assumptions are: (1) "Normal" CSF (of humans and dogs) has a relatively weak and characterless, so-called "S-shaped" ultraviolet absorption spectrum; and (2) "abnormal"[1] CSF's differ from "normals" by showing a strong and characteristic absorption spectrum with band peak at 265 mμ, which Spiegel, *et al.* (*10, 11*) and others (*1*) have attributed to nucleic acids.

We have been carrying on a systematic study of the ultraviolet absorption of the CSF since February 1946 and have analyzed[2] to date the CSF's of 80 humans, 5 dogs, and 12 cats. Contrary to the widely accepted assumptions stated above, we have found that the same strong 265-mμ band dominated the spectrum of the "normal" as well as of the "abnormal" CSF and was in either case due to ascorbic acid and not nucleic acid. In fact, no significant amount of nucleic acid has been found by us in either the "normal" CSF's of dogs, cats, or humans or in the "abnormal" CSF's of a large number of epileptic patients, a cocaine-convulsed dog, or 6 cats after cerebral concussion. The failure of Spiegel, *et al.*[3] and others (*5, 6, 9*) to observe the strong 265-mμ band in "normal" CSF has probably been responsible for the misinterpretation of the same band in the "abnormal" CSF. The weak "normal S-shaped" curve for CSF was described as early as 1927 (*5*) and unfortunately has been "confirmed" since by various investigators, with one exception (*7*). Strong sources of ultraviolet irradiation used in the measurement technique in earlier methods or other factors which destroy the easily oxidizable ascorbic acid readily explain the failure to observe its presence.

Our evidence for positively identifying the 265-mμ band in CSF with ascorbic acid has been derived from an extensive investigation (approximately 1,000 spectrophotometric curves have been analyzed) of the effects of a number of independent variables which affect its structure, and consequently the absorption spectrum, in characteristic fashion.

The unique qualitative and quantitative alterations of the spectrum of ascorbic acid when the pH is shifted and when different solvents are used (*14*) afford effective criteria for its identification. The effect of pH on ascorbic acid is pronounced, due to the marked difference in the spectrum of the ion and the undissociated molecule. When the pH of ascorbic acid in

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[1] "Abnormal" fluids are defined as fluids associated with abnormal neurological conditions, namely, (1) convulsive states induced in dogs by electrical shock; (2) human cases with nervous disorders such as epileptic or other convulsive states (*9, 11*).

[2] A Model D. U. Beckman quartz spectrophotometer and cells with a path length of 1 cm. were used.

[3] The presence of a strong band at 265 mμ was observed (*11*) in two out of three "normal" cases but was discounted.

Locke's solution is altered from pH 7 to pH 2, a relatively large shift of the maximum (200 A.) to shorter wave lengths occurs. Our data indicate that this is accompanied by a lowering of the extinction coefficient in the ratio of 1:1.6. A similar shift in spectrum is observed in comparing dilute solutions of ascorbic acid in water and in strong alcohol. The 265-mμ band in CSF shows not only the same wave length shift (Fig. 1) but also the correct extinction coefficient ratio. On the contrary, the spectrum of thymus nucleic acid shifts only slightly with a corresponding pH change and in the opposite direction to ascorbic acid, and is unaffected by alcohol.

Another test for ascorbic acid deals with its instability. The ready aerobic decomposition of ascorbic acid by catalytic oxidation may be produced in many ways: by irradiation with ultraviolet light, by increase in pH above 10 at room temperature, by addition of catalysts such as Cu ion, and by heat (decomposition occurs even at room temperature). The 265-mμ band in CSF responded to all of these decomposition tests. On the contrary, although thymus nucleic acid is decomposed by strong ultraviolet irradiation (*4*), we find that it is unaffected by any of the other tests.

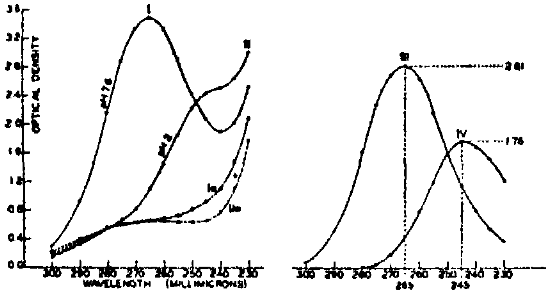

FIG. 1. I: A typical absorption spectrum of a "normal" CSF. II: Same CSF altered to pH 2. Ia: Same CSF returned to pH 7 after ascorbic acid destruction at pH 11. IIa: Same as Ia at pH 2. III: Difference curve obtained by subtracting Ia from I. IV: Difference curve obtained by subtracting IIa from II. Curves III and IV are identical with the absorption spectra of ascorbic acid at pH 7 and pH 2 as described by the positions of the maxima and the ratio of their extinction values (see text). The ascorbic acid concentration evaluated from each curve is the same (3.1 mg. per cent).

The observation by Spiegel, *et al.* of the disappearance of the 265-mμ band from a fresh sample of CSF is precisely what one might expect of ascorbic acid and therefore cannot be accepted as evidence for a chromatolytic enzyme which splits nucleic acids (*8*, *12*).

The unique properties of ascorbic acid not only aid in its identification but also make it possible to evaluate it quantitatively in CSF. Thus, an ascorbic acid analysis may be made by measuring the spectrum of a fresh sample of CSF before and after destroying the ascorbic acid by raising the pH above 11. By measuring the difference of extinction before and after destruction at both pH 7 and pH 2, two independent evaluations of the ascorbic acid concentration are obtained. A "normal" curve and the method of analysis are presented in Fig. 1.

It may be seen that the residual absorption (curve Ia) after the destruction of ascorbic acid gives the so-called "S-shaped normal" curve. Because purines and nucleic acids are not destroyed by the pH changes, they, if present, would appear in the residual curves. The residual curve of Fig. 1 is typical of both the "normal" and a large number of epileptic cases as well as of the "normal" and "abnormal" dogs and cats. The residual curve is due primarily to protein and to free amino acids. Purine, if present at all, can be in only trace amounts, because we have demonstrated that ultraviolet irradiation produces a rise in extinction, as it does for albumin (*3*), rather than a fall, as would occur if purines were present in significant concentrations. There is a minor distortion to wave lengths shorter than the maximum of serum protein which suggests the presence of insignificant amounts of other substances which may be purines. We have found occasional abnormalities in the amount and quality of the residual spectrum. These have been due to pathologically correlated increases of protein content, occasional increased "end" absorption which is hard to identify, and a few cases with additional characteristic absorption which have been identified as uric acid.

Incidentally, the concentration of uric acid in "normal" CSF has been negligible (certainly less than 0.5 mg. per cent), which is of significance to the ultrafiltrate theory of formation of cerebrospinal fluid.

Our values of ascorbic acid in CSF of the group of 80 mixed "normal" and "abnormal" patients (mostly the latter) range from 0.3 to 4.8 mg. per cent. This average value of ascorbic acid in CSF is twice the reported normal value for human blood plasma (*15*). Wortis, *et al.* (*13*), using the conventional chemical methods, have reported similarly high values of the ascorbic acid content of CSF compared with blood plasma. The average value and upper limit of the range is approximately three times greater than has been reported by other investigators, all European (*2*). The contrary findings may be due to dietary differences and to the difficulties of carrying out the chemical method of assay. The spectrophotometric measurements are direct and free from manipulation losses. We cannot state at this time whether or not a correlation in ascorbic acid content exists between "normal" and "abnormal" CSF's. The average ascorbic acid concentration of the 5 dogs was 2.5 times higher than that in humans and cats. These variations may reflect dietary differences.

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Comparison of the β-Glucuronidase Activity of Normal, Tumor, and Lymph Node Tissues of Surgical Patients[1]

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The physiological role of β-glucuronidase is believed to be that of "metabolic conjugation" (*2*), especially of the estrogenic hormones. In many animal experiments (*2, 4*) β-glucuronidase has been shown to be elevated specifically in response to estrogen injection. The excretion of large amounts of steroid glucuronides in pregnancy, an observation many times confirmed by others, was accompanied by elevations in blood glucuronidase activity (*1*). It was also reported (*1*) that malignant neoplasms of the breast and gastrointestinal tract contained more β-glucuronidase activity than did the corresponding uninvolved tissue.

TABLE 1

Patient†	Pathological diagnosis		Glucuronidase units*	
			Tissue	
	Lesion	Organ	Tumor	Normal
K	Benign fibroadenoma	Breast	393	325
C	Gynecomastia	"	267	—
W	"	"	96	—
L	Post-partum death	"	—	1,050
C	Carcinoma	"	890	140
R	" , scirrhous and medullary	"	1,930	62
M	Carcinoma	"	945	—
M	"	"	900	94
D	Fibrosarcoma	"	1,230	145
N	Fibroid	Uterus	405	—
L	*Myometrium at parturition*	"	—	844
V	Atrophy	"	—	365
H	Recurrent carcinoma	"	884	199
N	Normal endometrium	"	—	2,020
N	Adenocarcinoma	Colon	1,320	1,480
G	"	"	2,770	1,628
O	"	"	1,360	1,760
V	"	Rectum	900	1,930
M	"	Colon	5,250	2,490
N	Lipoma	"	126	1,311
L	Adenocarcinoma	Stomach	3,180	940
K	"	Cardia	1,510	750
B	"	"	2,180	650
B	Benign islet cell adenoma	Pancreas	960	600
E	Carcinoma, scirrhous	"	172	326
L	Post-partum death	"	—	1,045
N	Adenocarcinoma, metastatic	Liver	1,650	2,980
J	" , recurrent (ovary) mucinous	Abdominal wall	1,410	—
C	Carcinoma of ovary, recurrent	"	2,740	554 (mesentery)

* One unit is defined as 1 μg. of phenolphthalein liberated from phenolphthalein mono-β-glucuronide per hour at 38° from 1 gram of moist tissue under standard conditions (*3*).

† Patients previously studied (*1*) have been included for purposes of comparison.

At this time, confirmatory data are presented as well as some new observations on the β-glucuronidase content of human tissues (Table 1). The presence of relatively large amounts of β-glucuronidase in the involved lymph nodes of cancerous patients is reported for the first time (Table 2).

The main observations were as follows: Whereas minimal differences from normal were seen in benign fibroadenoma and gynecomastia of the breast, striking elevations were observed in carcinoma, fibrosarcoma, and in the proliferated lactating breast. In the uterus, the normal endometrium was high in glucuronidase. Carcinoma of the uterus contained more enzyme than did uninvolved uterine tissue. Uterine fibroid was relatively low in activity. In carcinoma of the gastrointestinal tract, elevations in glucuronidase occurred in the cardioesophagus, stomach, and less frequently in the colon. In tumors of the pancreas no change or a decrease in activity was observed. Adenocarcinoma, recurrent and metastatic to the abdomen, contained relatively large amounts of enzyme. Lymph nodes which have been removed from patients with cancer of the breast, colon, and prostate and with malignant melanoma contained excessive amounts of β-glucuronidase as compared with the corresponding uninvolved tissue.

TABLE 2

Patient	Pathological diagnosis	Site of tumor	Site of lymph node	Glucuronidase units	
	Lesion			Involved node	Uninvolved node
C	Carcinoma	Breast	Axilla	2,740	694
T	Malignant melanoma	Index finger	"	2,532	680
W	Carcinoma	Prostate	Cervical region	6,700	—
B	"	Colon	Mesentery	1,590	206

The observation of the enhanced β-glucuronidase activity of lymph nodes involved by cancer seems particularly important. Here, the lymph nodes may be considered to be tissue cultures of cancer cells, and this is where the highest glucuronidase concentrations have been observed. The same is true for mesenteric recurrences of cancer.

Two important questions arise from these results. Is enhanced glucuronidase activity a characteristic of cancer cells? If so, what is the significance of this finding?

In considering the first question, a clear-cut answer at first would appear difficult in view of the results in carcinoma of the pancreas and in a few cases of adenocarcinoma of the colon. However, if the tumor is small and is surrounded by much fibrous tissue, differences in activity may be impossible to demonstrate. Also, the adenocarcinoma of the colon involves both mucosal and muscle elements, whereas the control tissue has been colon mucosa, which possesses high glucuronidase activity. Nevertheless, 11 of 14 of the primary neoplastic tissues, 4 of 4 metastases to lymph nodes, and 3 of 3 recurrences to abdominal wall and uterus contained increased glucuronidase activity. Accordingly, the view may be taken that elevated β-glucuronidase is probably a characteristic of malignant cells, although a high glucuronidase activity in a tissue does not necessarily imply malignant change.

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[1] Aided by a grant from the Otho S. A. Sprague Memorial Institute. The technical assistance of Evelyn Gordon and Belle Springer is gratefully acknowledged.

The question of the significance of the presence of higher activities of β-glucuronidase in tumor tissues cannot be answered at this time. Studies of many other enzymes in tumor tissue have shown, in the majority of cases, a lowered activity as compared to the enzymic activity of normal tissues.

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Blood Plasma Ascorbic Acid Levels on Controlled Intakes of Ascorbic Acid

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A survey of the ascorbic acid status of college students reported from the University of Tennessee in 1944 (*1*) indicated a limited relationship between the fasting blood plasma ascorbic acid level and the calculated intake of ascorbic acid the preceding day.

An outgrowth of this work was a series of studies, from 1942 to 1947, with subjects maintained on controlled intakes of ascorbic acid. Considerable data were accumulated on blood plasma ascorbic acid values on these intakes. Since the plasma ascorbic acid is often determined in population survey studies, a statement of these values, with their standard deviations, may aid in the interpretation of survey data and indicate the dietary intake of ascorbic acid in these populations.

The subjects were 41 young women in their early 20's who weighed 44–76 kg., with an average weight of 57 kg. The fasting plasma ascorbic acid values given in Table 1 are 2-day and 6-day averages following 7- to 10-day adjustment periods at each level of intake. Fifty, 75, and 100 mg. were given daily as the synthetic vitamin. The diet contained an average of 7.1 mg. of reduced ascorbic acid. In the first experiments on 17 subjects, intakes were increased by intervals of 25 mg. Later, 24 subjects on the same intakes were studied, but with increasing and decreasing intervals of 25 and 50 mg. The changes in the time and intake schedules as the study progressed were the result of statistical evaluation of existing data and were made to enlarge the scope of the findings.

TABLE 1

Blood Plasma Ascorbic Acid Values With Standard Deviations for 41 Subjects (Mean Weight, 57 Kg.)

Intake ascorbic acid (mg.)	Plasma ascorbic acid (mg./100 ml.)	Standard deviations (mg./100 ml.)	Range (mg./100 ml.)
32	0.48	±0.137	0.34–0.62
57	0.72	±0.210	0.51–0.93
82	0.93	±0.196	0.74–1.13
107	1.05	±0.170	0.88–1.22

A 25-mg. ascorbic acid intake for 6 days or 2 weeks preceded the experimental periods. The blood plasma ascorbic acid values of subjects at this intake decreased or were barely maintained. Adjustment to intake is not claimed for this preliminary period, and the plasma ascorbic acid value given for it is undoubtedly high. A curve through the three experimental values places this plasma level at approximately 0.43 mg. of ascorbic acid/100 ml.

Overlapping of values at the intervals studied becomes more pronounced at the 82- and 107-mg. intakes, perhaps indicating adequacy at the lower level for some subjects. The standard deviation determines the range within which two-thirds of the plasma ascorbic acid values of subjects maintained on the corresponding intake will fall. The wide range in the plasma ascorbic acid values at each of the three levels of controlled intake indicates that any estimation of the vitamin intake of a population based on a plasma ascorbic acid survey cannot be narrowly defined.

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Humidity and Tolerance to Low Barometric Pressure

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During experiments in respiration at low pressure it became apparent that high humidities increase the ability of Swiss Albino mice to withstand reduced pressure.

Young male mice ranging in weight from 20 to 30 grams are placed in a small low-pressure chamber, and the pressure is reduced at the rate of 1 cm./minute. The behavior of the animals is closely observed, and the pressure at which respiration stops is noted. Provision is made for controlling the humidity of the air entering the chamber. Tests have been run at 22°, 10°, 0°, −10°, and −20° C. At each combination of temperature and humidity 10 or more animals have been tested.

At all temperatures used, air of 100 per cent humidity increases, in comparison to dry air, the tolerance of the mice to pressure reduction. This effect is most noticeable at −10° C., at which temperature mice in dry air die at an average pressure of 418 mm. Hg (15,500 feet simulated altitude). In air of 100 per cent humidity death occurs at 180 mm. Hg (35,000 feet). At other temperatures the beneficial effect of humidity is somewhat less, but still appreciable. The optimum conditions for survival of these animals are 0° C. and 100 per cent humidity, in which state the pressure is reduced to about 40 mm. Hg before death ensues.

Humidities of 65 and 90 per cent have been employed, but the results indicate that these humidities do not improve the tolerance of mice above that afforded by dry air.

Experiments to determine the effects of humidity on the tolerance of human subjects to reduced pressures, and low temperatures, are in progress. Also, the study on mice is being extended to include the effect of humidity on other respiratory factors.

Electrical Resistance of Whole Blood

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The circumstances accompanying blood coagulation are not yet clearly understood. It is probable that several components and one or more reactive processes are involved prior to the ultimate conversion of soluble fibrinogen to insoluble fibrin. The exact points of attack by the anticoagulants, heparin and dicumarol, are also not clearly defined. That the therapeutic use of these agents is not unattended with risk is well known. Clinical administration of the anticoagulants is commonly directed according to the observed clotting time, but this property appears not to be an infallible indicator. It is uncertain whether or not the too-frequently-unpredictable dosage responses arise from errors in the measurement of the clotting time or whether the extravascular clotting time is a relevant guide to therapy. Perhaps when the whole phenomenon of blood coagulation and the action of the anticoagulant drugs are better understood, some more pertinent index for clinical evaluation and drug application will be set up.

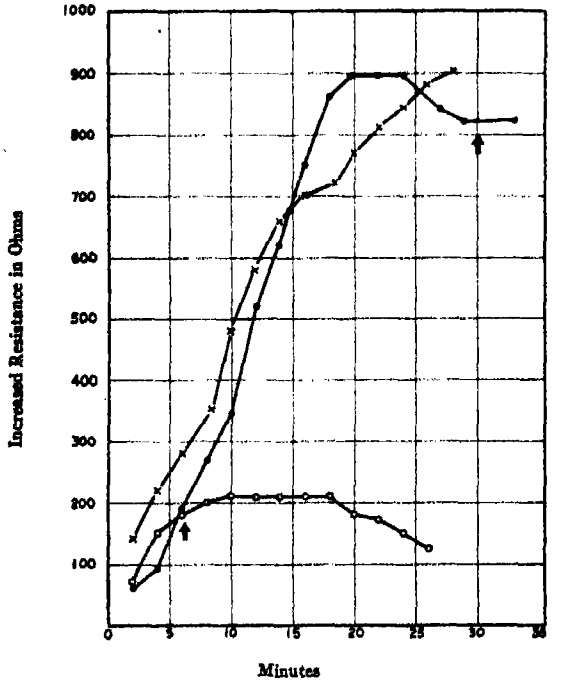

Fig. 1. Representative resistance-time curves: ○——○ Typical normal blood, ●——● Blood from patient receiving heparin over 48-hour period; ×——× Normal blood with excess heparin *in vitro*; ↑ Clot by Lee-White.

Further, the methods employed for the measurement of clotting time are highly subjective; the Lee-White method, which enjoys the widest use, yields reproducible data in skilled hands, but these data are not strictly referable to the data of other laboratories or technicians. It appeared, therefore, that it might be profitable to investigate other properties of the blood which might bear some relation to coagulation or which might change in a manner indicative of the clotting time. These properties must be susceptible to rapid measurement without introduction of extraneous mechanical or chemical factors such as agitation or dilution.

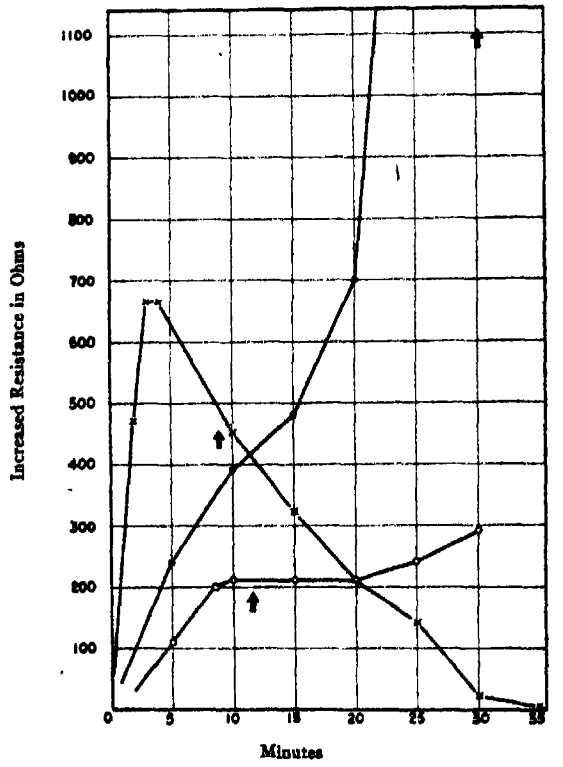

Fig. 2. Alteration in resistance-time pattern by administration of heparin: ×——× Initial blood before heparin; ○——○ Bood from same patient after heparin treatment for 18 hours; ●——● Blood from same patient after heparin treatment for 24 hours, last 8 hours under increased dose; ↑ Clot by Lee-White.

It was anticipated that electrical conductivity might be such a property and, even though it might reveal nothing further, it was expected that the resistance of the freshly drawn blood would increase until coagulation supervened, at which time an inflection in the resistance-time curve would occur. Figs. 1 and 2 demonstrate how well this prediction was realized, but—and this is perhaps of greater significance—these data also reveal certain wholly unexpected phenomena. In those instances where the coagulation time has been delayed by drugs *in vivo* or *in vitro*, there is an inordinate increase in resistance preceding clot formation when the latter is measured by the Lee-White method. Fig. 2 depicts one example where some intravascular defects were anticipated but wherein the extravascular clotting time was not greatly delayed. The blood specimen taken before medication exhibited a very high initial resistance with an accelerated change in resistance before coagulation. The accompanying curves show the alterations in the blood of this patient after administration of heparin.

These data appear to warrant further intensive investigation of the electrical resistance shifts in freshly drawn blood; such an investigation is under way in our laboratories. For the present we offer the speculation that this increased and increasing resistance is a consequence of the orientation or unfolding of certain plasma proteins in such manner as to form electrically neutral and unionized dipoles. The conductance of the proteins themselves might be thus inhibited, or the plasma electrolytes might be bound in the hypothetical double layer. The physiological significance of this phenomenon remains to be seen, but it is probable that the latter is affected significantly by the charge of the container—in this instance, pyrex glass. The hypothesis appears to be susceptible to experimental exploration.

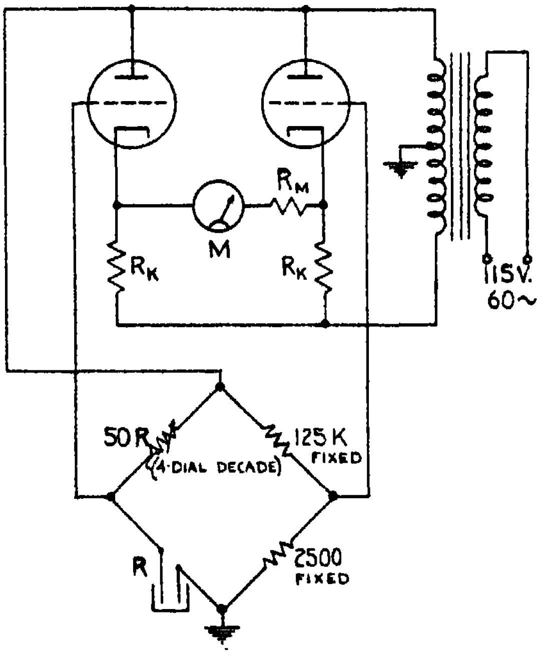

FIG. 3. Alternating-current electrolytic resistance bridge.

The measurements of electrolytic resistance were made with an alternating-current bridge[1] especially designed for this purpose (see Fig. 3). The use of 60-cycle alternating current eliminates polarization in the cell. The voltage across the cell is constant at balance and is equal to about 5 volts r.m.s.; this corresponds to a maximum power dissipation of ⅛ watt in the cell. In order to minimize the possibility of modification of the reactions in the cell arising from the passage of the measuring current, a switch is provided for closing the bridge energizing circuit only when a reading is taken.

A vacuum tube phase-detector and amplifier is used to amplify the bridge output voltage. A zero-center microammeter connected to the amplifier output is calibrated directly in the percentage by which the cell resistance deviates from the value indicated by the four decade dials of the variable arm of the bridge. The scale of the meter is graduated linearly from −15 to +15 per cent deviation. Cell resistances within the range of 200–10,000 ohms may be measured. The instrument is compact and portable and may be plugged into the house current supply at the bedside.

The conductivity cell constant was approximately 12 reciprocal cm.; this brought the measured resistance into the most accurate range of the bridge. Since the frequency is low and the electrodes small, it is obvious that the inductance and capacitance factors are minimal; certainly, the change with time of these parameters must be negligible except in so far as they might be affected by the speculative double layer.

Tracer Micrography[1]

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In the well-known method of radio autography a radioactive isotope is introduced in a biological or other system, and the distribution of that particular element within the system is determined by bringing the sample in close contact with a photographic emulsion. This method lacks resolving power because, even in the case of perfect contact of the sample with the photographic emulsion, the circle of confusion produced from every point of emission is so great that details less than .1 mm. are very hard or impossible to distinguish.

In order to improve the resolution of this tracer method, electron optical image formation was used for the determination of distribution of a radioactive element within a given sample. This is based on the emission of high-speed electrons by many tracer elements and the use of electron optical lens elements for forming an image on a photographic plate or other suitable recording surfaces. In the absence of any method for correction of the chromatic aberration of electron optical lenses, the first attempts were limited to elements which are emitters of monokinetic β-rays (internal conversion electrons). After some attempts with Cb^{95}, Y^{87}, $Sr^{85,87}$, and Pa^{233}, Ga^{67} was selected for the tests. Gallium chloride was prepared by chemical separation from zinc, bombarded by deuterons in the Department of Terrestrial Magnetism cyclotron, and the solution evaporated drop after drop on a ½-inch tantalum disk. The latter was used as the emitting surface at a distance of about 3½ inches from a photographic film. A magnetic lens consisting of an iron-clad coil with Armco iron pole pieces was used for forming the image. Fig. 1 shows the pole pieces of the magnetic lens, with a specimen inserted at left and a simple film holder attached to the right side. The conditions were selected so that a linear magnification of 1.6× was obtained. Vacuum requirements are very moderate; the mean free path of the electrons is large compared to the apparatus dimensions, even at forevacuum pressure. Preliminary experiments were made with samples of different concentration and thickness of the radioactive layer. Exposure times ranged from 2 to 12 hours, according to the age and concentration of the sample and the numerical aperture of the lens. As a quantitative example, the following may be given: 1 millicurie/mm.^{2} of Ga^{67} at a numerical aperture of 0.04 rad. and a magnification of 1.6× gives a satisfactory photographic density with 1-hour exposure. For the most part, Process-type emulsions were used for the recording of the image. Tracer micrographs can be obtained consistently with good definition if the layer is sufficiently thin to avoid considerable self-absorption. The best resolving power obtained thus far is about 30 μ. Fig. 2 shows comparative exposures of the same specimen both by the radio autograph and by the electron optical method. The electron optical exposures shown are taken with two different limiting apertures having diameters of 0.040 and 0.080 inch, respectively.

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[1] Manufactured by Matthew Conrad, Rahm Instruments, Inc., 12 West Broadway, New York City.

[1] The early phase of this work was carried out while one of the authors was attached to Stanford University. During that time work was carried out under a Rockefeller grant and with a considerable amount of collaboration on the part of J. Hamilton and E. Segrè. Their cooperation and the help of the Rockefeller Foundation is gratefully acknowledged.

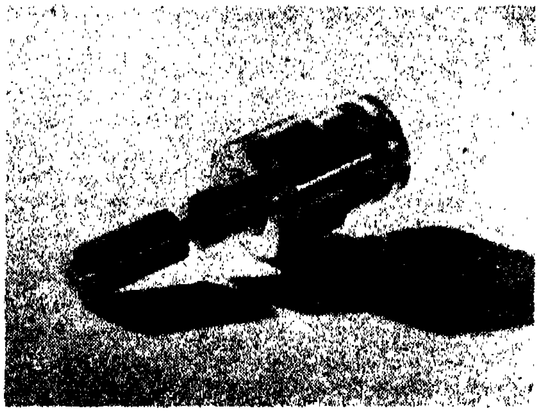

FIG. 1

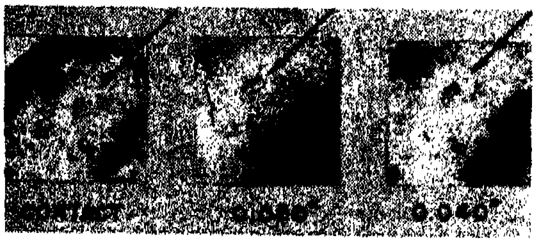

FIG. 2

Further improvements of the method include an afteracceleration of the β-particles. By such afteracceleration we hope not only to reduce the exposure times but also to achieve a better resolution through a reduction of the spherical aberration. A further reason for afteracceleration is that the chromatic aberration, which is always present (even in the case of monokinetic sources due to self-absorption), can be reduced markedly if the accelerating potential is at least comparable to, or greater than, the energy of the primary emission.

Staining of Nerve Endings in Mouse Epidermis by Feulgen's Nucleal Reaction

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So far as the writer is aware, there is no satisfactory method for the demonstration of nerve endings, especially in the epidermis. Most impregnation methods using metallic salts are tedious, fickle, and expensive. The chief objection is that the end result, even in successful preparations, though sometimes very beautiful, shows not the nerve itself but the black precipitate of silver salts.

During the study of the effect of methylcholanthrene on nerves in mouse skin, as part of a research project organized by E. V. Cowdry, of the Barnard Hospital, the writer found that nerves and nerve endings can be stained by Feulgen's nucleal reaction. Aside from being easy to operate, less time consuming, and quite specific, this method produces no precipitate. The technique is as follows:

Separate mouse epidermis from dermis by the heat method described by Baumberger, Suntzeff, and Cowdry (*1*), fixing it in 1 part formalin and 9 parts absolute alcohol saturated with picric acid (*2*). After carrying the tissue into water, hydrolyze and stain as for thymonucleic acid. The reagents used should be prepared as specified by Cowdry (*3*). It is not necessary to wash out the picric acid completely. Employ graded alcohols and xylols for dehydration and clearing. Mount in balsam for examination *in toto* or embed in paraffin for sectioning Staining must be carried out before embedding; otherwise, the stainability of the nerves is somehow impaired. No other precautions are necessary.

Epidermis prepared in this way shows nerve fibers together with their endings and cell nuclei. This coloration of nuclei is an advantage rather than a hinderance, for the relation of nerve endings to the surrounding cells is thereby clarified. The cytoplasm and other structures may be counterstained with fast green. Slides first prepared in October 1945 are still in perfectly good condition.

Liang (*4*), also of this laboratory, recently found that nerves can be stained by Schiff's reaction. Consequently, the process of hydrolysis may be omitted. The mechanism of staining is unknown. However, unless nerves and nerve endings are proved to contain thymonucleic acid, the specificity of nucleal reaction for this chemical compound is questionable.

References

1. Baumberger, J. P., Suntzeff, V., and Cowdry, E. V. *J. nat. Cancer Inst.*, 1942, 2, 413-423.
2. Bensley, R. R., and Bensley, S. H. *Handbook of histological and cytological technique*. Chicago: Univ. Chicago Press, 1938.
3. Cowdry, E. V. *Microscopic technique in biology and medicine*. Baltimore: Williams and Wilkins, 1943.
4. Liang, H. M. *Anat. Rec.*, 1947, 97, 103-104.

Book Reviews

Advances in protein chemistry. (Vol. 3.) M. L. Anson and John T. Edsall. (Eds.) New York: Academic Press, 1947. Pp. xii + 524. (Illustrated.) $7.50.

This third volume, like its predecessors, contains thorough and critical reviews by specialists of some of the fields of protein chemistry which have been particularly explored during the past few years.

In "The Chemical Determination of Proteins," P. L. Kirk discusses the physical and chemical methods used and emphasizes *inter alia* the pitfalls that can be encountered in the uncritical use of the Kjeldahl method for nitrogen in one or another of its innumerable modifications and the uncertainty of results obtained with salt fractionation of protein mixtures. This review is complemented by that of Max S. Dunn and Louis B. Rockland, "The Preparation and Criteria of Purity of the Amino Acids," which contains also a section on the synthesis of amino acids containing isotopic atoms. Particularly useful are the tables on the specific rotations, resolution, and solubilities of the amino acids, the Van Slyke nitrous acid and ninhydrin manometric methods, and the paragraphs on the semimicro Kjeldahl determinations. A table of references for microbiological determinations is also given.

Roger M. Herriott reviews the "Reactions of Native Proteins With Chemical Reagents" in oxidation, reduction, alkylation including the mustards and 2,4-dinitrofluorobenzene, acylation, deamination, diazotization, etc. Henry B. Bull presents "Spread Monolayers of Protein," primarily from the physical standpoint, while Alexander Rothen, in "Films of Protein in Biological Processes," reviews film transfer, spreading, enzyme films, immunological reactions, and his own results in studying plastic-covered protein films. Arne Tiselius, in "Adsorption Analysis of Amino Acid Mixtures," contributes a detailed discussion of the techniques and methods developed in his laboratory.

Anthony A. Albanese reviews "Amino Acid Requirements of Man," and Robert Elman, "The Use of Protein and Protein Hydrolyzates for Intravenous Alimentation." Both authors, however, seem to have overlooked an added use of protein hydrolyzates in the treatment of the hypoaminoacidemic crises of nephrotic children.

Leonor Michaelis discusses "Ferritin and Apo-Ferritin," and Alexander E. Braunstein reviews "Transamination and the Integrative Functions of the Decarboxylic Acids in Nitrogen Metabolism." The concluding article, "The Plasma Proteins and Their Fractionation," by John T. Edsall, is the most complete summary to date on the plasma proteins, their fractionation, physical properties, amino acid composition, and functions.

The great value of this book is enhanced by the very complete bibliographies and subject and author indexes.

FRANCIS P. CHINARD

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A bibliography of birds: with special reference to anatomy, behavior, biochemistry, embryology, pathology, physiology, genetics, ecology, aviculture, economic ornithology, poultry culture, evolution and related subjects. Reuben Myron Strong. Chicago: Field Museum of Natural History, 1939 (Pts. 1 and 2), 1946 (Pt. 3). Pp. 464; 469; 522.

This is a monumental work for which no praise is too great. When one reads the subtitle above, one wonders if anything has been omitted. And when one has leafed through Parts 1 and 2 (including rules and symbols employed, key list of abbreviations for periodicals cited, list of periodicals not cited but related to birds, and author catalogue of references) and has searched through Part 3 (Subject Index), he is convinced that no effort has been spared to provide the investigator with everything of value (except distribution, and systematics or classification). And yet no one knows better than the former editor of Vol. III of the *Bibliography of fishes* how impossible it is to get all the citations. No bibliography is ever finished. But for all this, Dr. Strong's *Bibliography of birds* will be the sure and solid foundation on which avian bibliographers will build in the long future.

Years ago, when Dr. Strong first conceived the idea of a bibliography of birds, the reviewer's advice was asked as to the method of procedure. It was suggested that he take the *Bibliography of fishes* (imperfect as it would be found in places) as a guide and that he improve on this work wherever possible. This Dr. Strong has done.

In the front of Part 1 is a key list of abbreviations for periodicals cited, with the names of the periodicals printed in full. This section standardizes the abbreviations and is of great help to beginners and to any who have to do with little-known journals.

When one comes to look up a citation one finds the surname of the author in bold-faced type and his given names in italics, set in a line on the left by themselves. In the vertical line below the surname is the date of each article, also set in boldface. Having author and date of publication in a vertical line on the left, it is easy to pick out the article wanted. If more than one article has been published in one year, these are indicated as 1910a, 1910b. Had these been set 1910.1, 1910.2, as in the *Bibliography of fishes*, they would look better and, with the period separating the 1 from the 1910, would be more easily read. Then too, at outer top of right and left pages are abbreviated guide names in boldface. It would have been better to have put the full name.

Another improvement of great value is the appearance at the end of certain book or journal references (if these are rare or little known) of such hieroglyphics as IJC, etc. Reference to pages 12 and 13 of Part 1 gives the name of the library in which the rare book or journal may be found. This will be of inestimable value to a host of users.

If, as we often hear said, bibliography is the sound basis of all research, then Parts 1 and 2 may be likened to a great storehouse of learning. Part 3, the Subject Index, is the guide to the particular shelves on which the wished-for data may be found. Here are segregated in alphabetical, chronological order the references to any particular bird, organ, or subject in which the researcher is interested.

But such an extensive warehouse must have a chart or guidebook to help the seeker. This, the Subject Index covering 522 pages, is the most extensive and elaborate known to the writer. The major headings have subdivisions, the latter have their subdivisions, and so on. Evidently Dr. Strong has not depended on the titles for indexing, but has looked up the articles themselves. This prolonged search will explain the multiple or cross references to many articles and books. The use of bold-faced type for the year of publication of an entry (with or without an asterisk) indicates an outstanding article, generally with extensive citation of literature.

One has to work over the Subject Index, however, to realize its thoroughness and its complexity. So great are these things that an alphabetical Finding Index is a necessary key for unlocking the door to the great wealth of the vast and complicated Subject Index. Such an index, now in preparation, is to be published as Part 4. When this has been accomplished and the treasures of this great work made easily available, it will be seen that this is surely *the* Bibliography of Birds, the most valuable tool ever forged for students of ornithology and an imperishable monument to the labors of the author.

E. W. GUDGER

The American Museum of Natural History, New York City

Organic analytical reagents (Vol. I.) Frank J. Welcher. New York: D. Van Nostrand, 1947. Pp. xv + 442. $8.00.

The use of organic substances as reagents in inorganic analysis dates back to the early days of chemistry; indeed, almost 2,000 years ago Pliny tested for iron with papyrus soaked in a solution of nutgalls. This test for iron is still used in vinegar works, although filter paper, cotton, etc. replace the papyrus. It was not, however, until 1905, when Tschugaeff introduced dimethylglyoxime as a specific and highly sensitive reagent for nickel, that the significance of organic analytical reagents was strikingly brought to the attention of chemists. Since 1905, especially during the past two decades, many new organic reagents have been discovered and improved techniques have been developed. In addition to serving as specific or selective reagents in gravimetric and colorimetric analysis, organic compounds have many other uses in analytical procedures, serving as solvents, dry extractants, concentrating liquids, wash liquids, buffers, oxidizing and reducing agents, protective colloids, flocculating agents, stabilizers for certain reagent solutions, coupling agents, primary standards, pH indicators, etc.

Organic analytical reagents is to be published in four volumes, making available in one place a description of all organic compounds employed in making analyses as well as laboratory directions for their use. Volume I includes Chapters on: "The Electronic Theory of Valence" (5 pp.), "Coordination Compounds" (11 pp.), "Chelate Compounds" (9 pp.), "Types of Chelate Rings" (17 pp.), "The Effect of Structure on Solubility" (7 pp.), "Hydrocarbons" (13 pp.), "Substitution Products of Hydrocarbons" (7 pp.), "Alcohols" (50 pp.), "Phenols" (71 pp.), "Miscellaneous Phenolic Compounds" (36 pp.), "Amino Phenols" (16 pp.), "Phenol Sulfonic Acids" (20 pp.), "8-Hydroxyquinoline and Its Derivatives" (81 pp.), "Azo Derivatives of 8-Hydroxyquinoline" (13 pp.), "Ethers" (15 pp.), "Aldehydes" (19 pp.), and "Ketones" (35 pp.). The book concludes with an index of names and synonyms of organic reagents and one on their uses, arranged alphabetically under the element or radical for which they are employed.

The volume is conveniently arranged for ready reference. The formula, molecular weight, Beilstein reference, properties, and method of preparation are given for each reagent, as well as references to the original literature.

In the first printing of a work of this nature and scope it is difficult to avoid errors. The following are representative of those noted. In Table 5 (p. 22) the bond angles for 8-membered rings should be −25° 32′ and −21° 35′ for zero and one double bond, respectively, and −9° 44′ for four double bonds; for 9-membered rings with four double bonds the value is −16° 29′. On page 21, third paragraph, three of the bond angles for 7-membered rings are incorrect; the correct values are given in Table 5. On page 249, the molecular weight of $(HO_3S)_2$-$C_6H_2(OH)_2$ is given as 358.2; the correct value is 270.23. Actually, the monohydrate of the disodium salt of this acid is employed, and its molecular weight is 332.2. The sensitivity of this reagent for titanium (p. 251, line 5) should read: "1 part of titanium in 100,000,000 parts of solution . . . ."

The great number and variety of organic compounds offers one of the most promising sources for new and better analytical reagents. Volume I of this series is a valuable addition to the reference works in this interesting field of analytical chemistry and, together with the three succeeding volumes, will make a most useful treatise on organic analytical reagents.

JOHN H. YOE

University of Virginia, Charlottesville

Scientific Book Register

COLIN, EDWARD C. *Elements of genetics.* (2nd ed.) Philadelphia-Toronto: Blakiston, 1947. Pp. xiii + 402. (Illustrated.) $3.50.

EIDINOFF, MAXWELL LEIGH, and RUCHLIS, HYMAN. *Atomics for the millions.* New York-London: McGraw-Hill, 1947. Pp. xiv + 281. (Illustrated.) $3.50.

MARKLEY, KLARE S. *Fatty acids: their chemistry and physical properties.* New York: Interscience, 1947. Pp. x + 668. (Illustrated.) $10.00.

MICHENER, WILLIAM H. *Physics for students of science and engineering.* New York: John Wiley; London: Chapman & Hall, 1947. Pp. x + 646. (Illustrated.) $4.25.

RIDENOUR, LOUIS N. (Ed.) *Radar system engineering.* New York-London: McGraw-Hill, 1947. Pp. xviii + 748. (Illustrated.) $7.50.

The Native Protein

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RESULTS OBTAINED IN PHYSICAL chemistry and chemical crystallography yield a rather definite picture of the native protein which fits at many points with that emerging from the various fields of the biology of the proteins, *i.e.* enzymology, immunology, pharmacology, virus studies, and genetics. If we attempt to sum up the general impression derived from a study of various independent sources of information on the proteins, it can be broken down into the following parts:

(1) Many proteins in solution are particles, not individual molecules (*21*). It is useful to use the term *proteon* to connote a native protein unit incapable of division into subunits also having the native protein character. Every native protein may then be regarded as a proteon or a system of proteons, alike or different. That a protein particle is not a mere conglomerate of proteons but an orderly aggregate, *i.e.* a molecular colony, follows from the finding that in many cases where ultracentrifugal studies show that a protein is uniform in size and shape under well-defined external conditions, the protein in question is capable of dissociation into subunits when the environmental conditions are modified (*21*). Much information has now been assembled concerning the particle status of many proteins, ranging from the very large tobacco mosaic nucleoprotein down to horse hemoglobin. The reversible dissociation of protein particles does not imply any change in the chemical status of the proteons. It is therefore to be sharply distinguished from denaturation.

(2) Interproteon associations within particles depend upon the R-substituents of the amino acid backbones ($N—C_\alpha—C$) which make up the proteon skeletons. Structure chemistry provides three types of association: direct polar, mediated polar, and less polar. Horse hemoglobin, which on dilution dissociates into two subunits, provides an illustration of the first type; the Helix hemocyanin particle whose dissociations in aqueous solution are affected by Ca^{++} and Mg^{++}, an illustration of the first and second types (*21*). That the less polar R-substituents of aliphatic and aromatic types, as well as the more polar types, emerge from protein surfaces is indicated by many data, e.g. the higher solubility of insulin in propylene glycol than in water and the affinity of human serum albumin for the paraffin chains of fatty acid molecules (*13*). Thus, associations of the third type are also a possibility, and the fact that studies in aqueous solution give two subunits per particle (e.g. for horse hemoglobin) does not preclude the possibility that these subunits may themselves be particles in which the proteons are associated by less polar R-groups. Such a situation is increasingly indicated by crystallographic studies (*6*).

(3) The proteon skeleton is an *intrinsically unstable structure*. This is seen, for example, in the fact that each protein has its own pH stability range. Its stability depends upon the energy provided by the association of favorably placed polar R-substituents which can be direct or mediated by foreign molecules or ions. The minimum solubility of a protein in the neighborhood of its isoelectric point and the general instability of proteins on dilution (*4*) are further indications of this situation. The fact that the proteon, apart from its R-groups, is unstable means that there is, in the skeletons of native proteins, a labile bond. That the protein skeleton is rigid, we know from both crystallography (*6*) and physical chemistry (*10*). Evidently it is this labile bond which is responsible for the rigidity. That the labile bond joins skeletal atoms and not atoms belonging to R-substituents is inherent in the viewpoint which emerges from chemistry as a whole. Just as the sterol skeleton embodies the sterol character, the protein skeleton embodies the protein character, irrespective of the particular amino acid compositions of individual proteins. To reject this viewpoint is to exclude the proteins from the fabric of present-day chemical ideas. The protein molecule may be viewed as a triumph of atomic engineering in which there is a "compression" member comprising the skeletal atoms and a "tension" member comprising the R-substituents with hydrogen bridges and hydrogen bridge circuits as "ties." The relation between the skeleton and the associational complex of its substituents is thus essentially symbiotic. Only with the stabilization energy provided by the associations of its substituents can the skeleton continue to exist; only so long as the skeleton remains intact are the sites or roots of the substituents held in spatial positions which permit the formation of associations. In the associational complex of substituents resides the physicochemical individuality of a proteon; upon it depends its biological specificity.

THE PROTEIN SKELETON

The major unsolved problem in the structure of proteins is the nature of the protein skeletons. It is to be expected that these skeletons are entities as definite as, for example, the carbon skeleton of the sterols or the carbon-

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Based upon the Stieglitz Memorial Lecture, American Chemical Society, Chicago, January 1947.

nitrogen skeleton of hexamethylene tetramine. The information required, before fundamental progress in understanding protein structure can be made, is a blueprint showing the positions in space of every N, every C_α and every C in the skeleton or skeletons. It is necessary, therefore, to discover how the $(N-C_\alpha-C)$ units are interlocked to form a rigid skeleton and, incidentally, the number or numbers of amino acid residues capable of building such integrated structures.

One important issue, generally the first to be discussed in an analytic study of an unknown structure, is symmetry. The fact that all the $(N-C_\alpha-C)$ units in proteins have the C_β atom attached to the C_α in the same (levo-) position narrows the possibilities regarding the symmetries of protein skeletons, since it eliminates all types involving a center of symmetry or a mirror plane. Twelve possibilities comprise: two cubic, O and T; two hexagonal, D_6 and C_6; two rhombohedral, D_3 and C_3; three tetragonal, D_4, C_4, and S_4; one orthorhombic, D_2; one monoclinic, C_2; and one triclinic, C_1. Each will require investigation in turn. So far only cubic symmetry has been considered (*25*). So many facts regarding proteins fall into place if it is assumed that protein skeletons have cubic symmetry that this assumption and its far-reaching implications merit detailed investigation and study. The hypothesis at once explains how it can happen that a number of proteins, unlike organic molecules in general, form crystals of high symmetry (*6*, *7*). It explains, also, the variety of space groups exhibited by protein crystals (*6*, *7*). The body of knowledge comprised in the atomic structure of minerals (*2*) shows exactly the lines upon which such a situation can arise, provided a cubic skeleton is characteristic of all proteons. Proteons form particles, often of immense molecular weights, which, to the limit of sensitivity of the ultracentrifugal technique, are uniform in shape (*21*). The cubic hypothesis explains how this can happen. Molecules built on cubic skeletons can form particles by the association (as it were) of faces, edges, or vertices, after the manner of the silicates (*2*), thereby building aggregates which are of definite morphology, even though they may be large. There seem to be many indications that only a cubic skeleton can build particles of definite morphology having the variety of shapes exhibited by protein particles. The variety of optical characters (*12*) is also explained. Since the cubic skeleton is necessarily isotropic, the optical character of a protein crystal depends upon the nature and arrangement of its particular R-substituents.

In this connection, the idea presents itself that a local situation on the surface of a protein molecule or within a protein particle may be, to all intents and purposes, a replica of a local situation in a mineral (*26*). Metals ions are known to be associated with many proteins, e.g. manganese with arginase, zinc with carbonic anhydrase, copper with phenolases, iron with catalase, peroxidase, cytochromes, and lactic dehydrogenase. With mineral precedents in mind, we can picture a metallic ion, for which a tetrahedral or an octahedral environment of oxygens is appropriate, clamping together protein molecules, each carrying glutamyl or aspartyl substituents. We can also picture hydrogen bridge circuits, of the types found in ice (*1*) and in various organic crystals, such as pentaerythritol (*5*) and acetamide, (*18*) engaging substituents of protein molecules. Such situations involve symmetry elements also. A cubic skeleton permits, though it does not require, such associational complexes of its substituents. It would also permit the integration of individual hydrogen bridge circuits by water molecules into a multiply-connected network covering the whole molecule. Proton jumps or transfers, of the type already postulated in ice, would then allow the entry and exit of protons at widely separated points. The suggestion may be made that the essence of a protein capable of enzymatic activity may reside in such a network over its surface. Long-range forces for proteins, which have been postulated for some time, provide, it would seem, the only explanation of biological phenomena such as those concerned with the pairing of chromosomes and the mitotic cycle in general (*22*). They have recently been postulated, even more definitively, on the basis of revolutionary results concerning protein interactions at distances of the order of 100 A. (*14*, *15*). That an enveloping network of multiply-connected hydrogen bridge circuits may prove to be the seat of such forces is worthy of the most careful consideration.

A Theory of Biosynthesis

Whether our concern is with the possibility of long-range forces or with the nature of enzymes, protein function may be regarded as the outward sign of an inner essence. It is therefore to be expected that the most fundamental of all protein functions, the production of replicas, may throw light upon the nature of protein structure. (It is of interest in this connection that the function of replication is gradually being extended to more and more proteins, *20*.) A theory of biosynthesis is therefore presented for consideration. It is based upon the belief that replication is akin to crystal growth and so belongs essentially to the domain of crystallography, the richest repository of ideas for structure studies in general and indispensable in any attempt to understand the proteins.

The replication of proteins falls into two parts: the replication of protein molecules and the assembling of protein molecules into protein particles. The former is the crucial happening in protein synthesis.

For molecular replication, three basic assumptions are required:

(*1*) We assume that the inherent capacity of certain species of protein to produce replicas depends on the presence on their surfaces of *active patches* (to use Warburg's term), *i.e.* local specific constellations of R-substituents. Each of these, we must presume, can function as a mold or templet, permitting the laying down on itself of a complementary constellation. Under what circumstances, then, will such constellations provide appropriate material for new, hitherto-non-existing proteons which are exact replicas of those already existing? Evidently, in the first place, this occurs only if a proteon is in some sense, a surface structure—a stiff fabric of some kind forming a 'space-enclosing' shell. This requirement accords well with the fact that all proteins, no matter how large they may be, produce monolayers of the same thickness, 7–11 A. Secondly, it is necessary that the constellations complementary to those comprising an existing proteon be equivalent to the constellations themselves. Thus, we might take a molecule of the same shape as, for instance, hexamethylene tetramine, but larger and analyze its surface into various patches. Suppose now that each patch of the surface is complementary to the antipodal patch. This would mean that the patch synthesized on, and complementary to, one part would actually be the antipodal patch. In such a case, then, the synthesis by individual molecules of complementary patches would *ipso facto* produce the patches capable, when correctly assembled, of making new molecules which are exact replicas. Thus, the first deduction to be made regarding protein molecules is that they are surface structures, comprising a set of individual patches which form a self-complementary set.

(2) In order to have a mechanism whereby these isolated constellations on different molecules may, on occasion, be integrated so as to interlock, in the same spatial pattern as in the original molecules, something has to be postulated regarding the capacity of the original molecules to form orderly assemblies. In such a case, we can picture the incipient crystallization of the existing molecules permitting complementary patches to interlock, step by step, in a variety of sequences, into precisely the pattern in which the patches are integrated in the existing molecules. We see then that the global self-complementariness of the surface of a protein molecule belonging to a species capable of replication can be more precisely defined. It must be "crystallographically satisfactory"; the incipient crystallization of existing molecules then so sets the individual complementary patches that interlocking into new and identical molecules results. In the example cited, the antipodal patches form pairs of complementary patches. In the case of the phosphotungstic acid anion, patches of the surface are self-complementary. There are, in fact, a well-defined number of ways in which a crystallographically satisfactory global self-complementariness can be achieved. One of these ways must be characteristic of the synthesizing proteins; which, we do not yet know. It is worth emphasizing that whichever alternative is adopted by proteins, one apparent difficulty disappears. It has been stated that there is some objection to postulating the formation of a complementary pattern, since a protein produces not a complementary pattern but a replica of the original (*3*). The difficulty evanesces when it is seen that the molecule results from the integration of individual complementary patches, which may be, but need not be, replicas of the patches on which they are synthesized, and that it is only the appropriate *global self-complementariness* of the molecules which ensures replication.

(3) The energy questions involved in protein synthesis point in the direction of certain ancillary molecules being present during such operations, e.g. molecules containing energy-rich phosphate bonds. It should be noted in this connection that among the many crystalline *nucleo* proteins already well known, bushy stunt virus nucleoprotein achieves even a *cubic* space group (*7*). That nucleic acid plays an essential role in replication has long been assumed (*20*, *24*).

PROTEIN INTERMEDIATES

This theory of biosynthesis has a number of implications, some of them far reaching. It is sufficient here to refer to one of them—the existence of protein intermediates. These may be visualized as the various individual active patches upon which complementary constellations are formed. There are indications that such structures may already have been found in no less than a dozen cases, e.g. in the lactalbumin precursor (*19*), in the digestion products of beef pseudoglobulin (*11*), β-lactoglobulin (*8*), and casein (*23*), and in hydrolytic products of silk (*9*). These products are all of low molecular weight corresponding to amino acid residue numbers in the range 4–12, clearly indicating that the smallest—perhaps the only—proteon skeleton may comprise relatively few residues. It is to be emphasized that the products in the last case have biological activity, connoting a definite structure. Biological activity has been found in protein monolayers in a variety of cases which include ovalbumin, horse serum albumin and globulin (*17*), and insulin and metakentrin (*16*). In the case of the globulin, it proved necessary to compress the film to 15 dynes or so (*17*). A structure capable of biological activity only under such circumstances may well contain a labile bond. All these facts point to one conclusion, which is exactly that reached in the discussion of biosynthesis. The proteon, it would seem, is an integration of parts of definite structure and individuality. The immense difficulty of the study of the *structure* of proteins (in contrast to *composition* of proteins) by way of organic chemistry needs no emphasis. But a new approach opens when we think in terms of protein intermediates and aim at a more limited objective. The application of the general ideas which presented themselves in the consideration of the symmetry of the protein skeletons to the possible structure of such protein intermediates yields various specific suggestions regarding the particular amino acid residues which may be expected in conjunction (*26*). A systematic study of the amino acid compositions to be expected of active patches can now be undertaken. The complete characterization of protein intermediates and their resynthesis would mark a crucial stage in protein studies.

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Tidal Illumination Diagrams

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THE TIDAL ILLUMINATION DIAGRAM IS one of the various graphic devices designed during the recent war to represent significant hydrographic conditions on military targets. It was introduced by the Oceanographic Section of Headquarters, Army Air Forces, in 1942 to represent relationships between stage of the tide and state of illumination in target areas of Northwest Africa. Later, its use was extended to all theaters, and preparation on a mass scale was taken over by the U. S. Coast and Geodetic Survey, where facilities are available for computation and graphic presentation of these data for many parts of the world. Recent comments have shown the diagrams to be of practical use in this postwar period.

The tidal illumination diagram is so arranged that for any hour of the day combinations of solar illumination and stage of the tide are readily noted. Heights of high and low tides are referred to the sound datum of nautical charts of the specific locations. In so far as possible, tidal data from the U. S. Coast and Geodetic Survey tide tables are used. The occurrences of high and low tides are shown as a series of connected points enabling the user to visualize the changing sequence throughout the month. Days of the month are represented by vertical lines covering the period from noon through midnight to noon of the next day.

Three types of twilight are indicated to bring out gradation in light from sundown to darkness and from darkness to sunrise. Civil twilight begins with sunset and ends when the sun is 6° below the horizon. During this period, objects may be distinguished readily, and a newspaper may be read without the aid of artificial light. At its end, sky brightness is approximately 20 times that of the full moon at zenith (Fig. 1). In the following period of nautical twilight, the brighter stars are visible, the horizon is

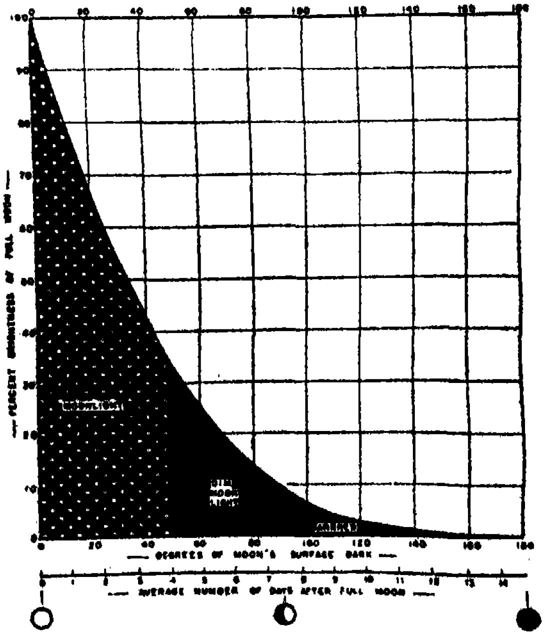

FIG. 1. Relative brightness of moon with change of phase.

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[1] Contribution No. 382.

generally indistinguishable, but general outlines of objects not too distant can be distinguished. Astronomical twilight begins when the sun is 12° below and ends when it is 18° below the horizon. *During this period, illumination* is distinctly brighter than during complete solar darkness but less than during periods of dim and brilliant moonlight (Figs. 2 and 3).

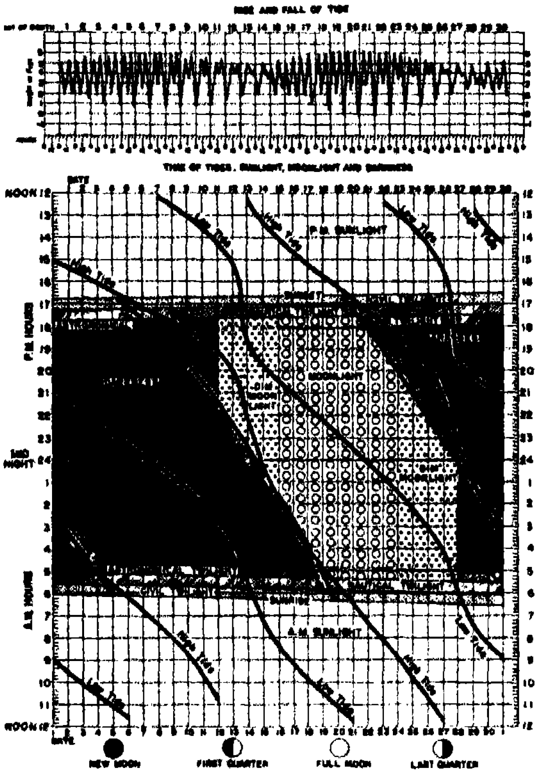

FIG. 2. Tidal illumination diagram for Yokohama, Japan, at time of occupation, November, 1945.

Variations in moonlight intensity are arbitrarily divided into periods of bright and dim moonlight. Bright moonlight is taken as the period from four days before to four days after the appearance of full moon, during which time light intensity varies between full moon brightness at its zenith and about one-third of this value (Fig. 1). The period of dim moonlight includes four days prior to the beginning of bright moonlight and four days after its end, during which time illumination intensity varies from about one-third to about one-tenth of full moon brightness at zenith. The relative brightness of the moon with phase is illustrated by Fig. 1.

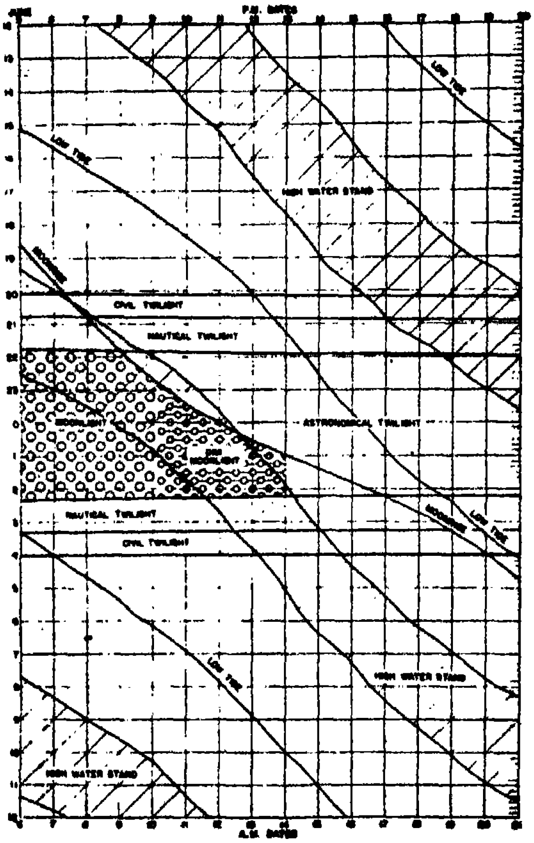

FIG. 3. Tidal illumination diagram for "Omaha" Beach, Normandy, France, during invasion, June 1944.

Tidal illumination diagrams for important target areas of World War II are illustrated by Figs. 2 and 3. These can be prepared for any coastal area where tides have been predicted; their usefulness lies in the prognosis of future conditions as well as in historical studies.

NEWS *and Notes*

"An American Bridge to World Science" (*Science*, May 9, p. 483) outlined the opportunities which might accrue to scientists by virtue of the provisions of the Fulbright Act. This law authorizes agreements with foreign governments for the use of money derived from the sale of surplus property to "finance studies, research, instructions, and other educational activities" of American citizens in the educational institutions of such countries and to transport their own citizens who wish to attend schools in the United States. The law further provides that the President shall appoint a 10-man Board of Foreign Scholarships to select both students and institutions and to supervise the exchange program. Last week such a Board was appointed. The only scientist member is Ernest O. Lawrence, professor of physics, University of California. Others named to membership were: Veterans Administrator Bradley; John W. Studebaker, U. S. Commissioner of Education; Francis Spaulding, New York State Commissioner of Education; Helen C. White, professor of English, University of Wisconsin; Laurence Duggan, director, Institute of International Education; Sarah Blanding, president, Vassar College; Walter Johnson, professor of history, University of Chicago; Charles S. Johnson, president, Fisk University; and Martin P. McGuire, dean, Graduate School, Catholic University. The State Department has already received 12,000 applications for study abroad, 5,000 of these being from veterans.

The $137,550,000 made available thus far is distributed among 22 countries, as follows: Australia, Finland, France, Hungary, and the Netherlands, $5,000,000 each; Austria, $750,000; Belgium, Denmark, Egypt, and Burma, $3,000,000 each; Czechoslovakia, $6,000,000; Greece and Poland, $8,000,000 each; Iran and the Philippines, $2,000,000 each; Italy, China, and the United Kingdom, $20,000,000 each; Netherlands Indies, $7,000,000; New Zealand, $2,300,000; Siam, $4,000,000; and Turkey, $500,000.

Science readers are again referred to "An American Bridge to World Science" and the implications of the Act as presented by William Vogt.

National Science Foundation legislation was, at the beginning of this week, in the hands of conferees from both the House and Senate in order that a compromise might be reached on such issues as appointment of a Director, allotment of research funds to states, and patent provisions. Senate conferees are: Aiken, Ellender, Smith (author of S. 526), Taft, and Thomas; for the House, Harris, Hinshaw, Howell, Priest, and Wolverton (author of H. R. 4102, discussed in last week's issue of *Science*). It seems likely that within a few days a Science Foundation bill will be on its way to the desk of the President for signature.

About People

P. A. Lehenbauer, head, Department of Biology, University of Nevada, has recently retired from that position and is succeeded by **E. W. Lowrance.**

Harold Wooster, University of Pennsylvania, has been appointed senior fellow on the Heinz Food Varieties Fellowship at Mellon Institute.

Iver J. Johnson, professor of agronomy, Iowa State College, has been appointed successor to **H. D. Hughes,** head, Farm Crops Subsection, Department of Agronomy, Iowa State College Agricultural Experiment Station, and head, Farm Crops Subdepartment, Agronomy Department, Division of Agriculture, Iowa State College. Prof. Hughes retired on June 30.

Gilbert H. Ayres, Department of Chemistry, Smith College, has been appointed associate professor in the Chemistry Department, University of Texas. Dr. Ayres will be in charge of analytical chemistry.

Rudolf Bennitt, professor of zoology, University of Missouri, has been appointed visiting professor of zoology at Washington University, St. Louis, for the current summer session.

Ruth McClung Jones, assistant professor of zoology and botany, Swarthmore College, has been appointed professor of biology at Winthrop College, the South Carolina College for Women, Rock Hill.

Norman Foster Ramsey, formerly of Columbia University, has been appointed associate professor of physics, Harvard University. Prof. Ramsey will also continue to serve as consultant to the Brookhaven National Laboratory.

Herman H. Chapman, Harriman professor emeritus of forest management, Yale University, received the honorary D. Sc. degree from the University of Minnesota at its recent commencement exercises.

L. R. Hafstad, director of research, Applied Physics Laboratory, Johns Hopkins University, has been appointed executive secretary of the Joint Research and Development Board, succeeding **Lloyd V. Berkner,** who resigned July 1, and who expects to return in the fall as chairman of the Division of Upper Atmosphere Physics, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

R. E. Black, formerly senior research chemist, Phillips Petroleum Company, Bartlesville, Oklahoma, has been appointed professor and head, Department of Chemistry, Morningside College, Sioux City, Iowa. Prof. Black assumed his duties June 1 after the retirement of **J. A. Coss.**

Hugh Cutler, formerly of the Botanical Museum, Harvard University, and field technician, U. S. Rubber Development Corporation, Brazil, during the war, has been appointed curator of Economic Botany at the Chicago Natural History Museum.

Percy E. Raymond, professor emeritus of paleontology, Harvard University, has been elected a corresponding member of the Geologiska Föreningen, Stockholm.

Ancel Keys, director, Laboratory of Physiological Hygiene, and professor, School of Public Health, University of Minnesota, flew to England July 12 for a two-week series of addresses and conferences. Dr. Keys gave the opening address of the symposium on malnutrition at the International Congress on Pure and Applied Chemistry in London.

W. E. Krauss, head, Department of Dairy Husbandry, Ohio State University College of Agriculture for the past year, will return to the Ohio Agricultural Experiment Station at Wooster as its associate director, January 1, 1948.

David E. Green, director, Enzyme Chemistry Laboratory, Columbia University, has been appointed professor of enzyme chemistry, University of Wisconsin Medical School.

Clarence F. Goodheart, Naval Ordnance Laboratory, White Oaks, Maryland, and **Chester H. Buchanan,** professor and head, Department of Electrical Engineering, University of North Dakota, have been appointed associate professors of electrical engineering, Union College, Schenectady, New York.

Ernest A. Back, entomologist, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, since 1907, retired June 30. On August 1 Dr. Back will leave for London, where, with **R. T. Cotton,** head of the Bureau's Manhattan, Kansas, laboratory, he will represent the Department of Agriculture at the international conference of specialists on infestations of stored products, sponsored by the Food and Agriculture Organization.

Daniel Melnick, supervisor of research, Food Research Laboratories, Inc., has been appointed director, Institute for Applied Research (successor to Applied Research Laboratories, Inc.), Dayton, New Jersey.

W. Henry Hollinshead, formerly professor of anatomy Duke University School of Medicine, has been appointed consultant in anatomy and professor of anatomy at the Mayo Foundation and Graduate School of Medicine, University of Minnesota.

John E. Anderson, director, Institute of Child Welfare, University of Minnesota, has been granted sabbatical leave of absence for the year 1947–48. **Dale B. Harris** will be acting director of the Institute during this period.

Harold A. Abramson, assistant professor of physiology, College of Physicians and Surgeons, New York City, and associate physician for allergy, The Mount Sinai Hospital, has been appointed active consulting physician for allergy, Seaview Hospital, Staten Island, New York.

Walter V. Bingham, chief psychologist and adviser regarding the classification of military personnel, War Department, for the past seven years, resigned June 30. Dr. Bingham will serve part time as an expert consultant to the Secretary of War, and as chairman, Council Advisory to the Director of Personnel and Administration, War Department General Staff.

William H. Chambers, chief, Toxicology Branch, **Harold E. Himwich,** chief, Clinical Research Branch, and **Leonard Karel,** toxicologist, represented the Medical Division, Army Chemical Center, at the centenary celebrations of the Chemical Society, London, July 15–17, and the subsequent International Physiological Congress at Oxford.

Warren D. Smith, head, Department of Geology and Geography, University of Oregon, retired on July 1. Prof. Smith is president-elect of the Oregon Academy of Science.

Frederic C. Schmidt, associate professor of chemistry, Union College, has been appointed associate professor at Indiana University, effective September 1. Dr. Schmidt is succeeded at Union College by **Harry F. Herbrandson,** at present a research fellow at Harvard University.

F. C. MacKnight, formerly geologist with The Texas Company, New Orleans, has been appointed professor of geology and geography at Evansville College, Evansville, Indiana.

Raymond L. Taylor, resident head, Department of Biology, Sampson College, Associated Colleges of Upper New York, has been promoted from associate professor to full professor.

Morgan Upton, industrial psychologist, Murray Corporation of Detroit, has been appointed professor, and chairman, Department of Psychology, Rutgers University.

R. E. Buchanan, director, Agricultural Experiment Station, Iowa State College, and **C. H. Werkman,** head, Department of Bacteriology, participated in the 4th International Congress for Microbiology, held this month in Copenhagen, Denmark. Dr. Buchanan helped prepare an international code of bacteriological nomenclature which was presented at the Congress, and Dr. Werkman, one of the principal speakers, discussed cellular metabolism.

Simon H. Ingberg, chief, Fire Resistance Section, National Bureau of Standards, Washington, D. C., has recently retired from this position.

Harry Eagle, Johns Hopkins University School of Hygiene and Public Health, has been appointed scientific director of the National Cancer Institute. Dr. Eagle will have charge of an extensive program of research within the Institute, which is a part of the U. S. Public Health Service.

Henry M. Burlage, professor of pharmacy, University of North Carolina, has been appointed dean, College of Pharmacy, University of Texas, effective September 1, 1947.

David B. Hand, director of research and quality control, Sheffield Farms Company, Inc., has been appointed professor of biochemistry and head, Division of Food Science and Technology, New York State Agricultural Experiment Station, Geneva. Dr. Hand succeeds **Elmer H. Stotz,** who has been appointed professor of biochemistry and chairman, Department of Biochemistry, University of Rochester School of Medicine and Dentistry.

Robert F. Loeb has been appointed Bard professor of medicine in the College of Physicians and Surgeons, and director of the Medical Service at Presbyterian Hospital, according to announcement by Frank D. Fackenthal, acting president, Columbia University, and Charles P. Cooper, president of Presbyterian Hospital. Dr. Loeb has been Lambert professor of medicine at Columbia and attending physician at the Hospital and, during the war, served as consultant to OSRD and chairman of the Board for the Coordination of Malarial Studies. Dr. Loeb succeeds **Walter W. Palmer,** who has become emeritus professor of medicine and consultant of the Hospital.

Edwin R. Whitehead, since last October half-time research professor of electrical engineering and consultant in electrical engineering in general charge of the AC network calculator at Armour Research Foundation, Illinois Institute of

Technology, has been appointed director of the latter's Department of Electrical Engineering. Dr. Whitehead succeeds **Louis T. Rader**, who will join the staff of the General Electric Company.

George H. Young, on the research staff of Mellon Institute since 1935 and executive assistant to the director for the past three years, has been promoted to an assistant directorship of the Institute. During the war Dr. Young was a special consultant on corrosion and protective coatings to the War and Navy Departments.

William W. Ray, associate professor of botany and plant pathology and associatd plant pathologist and mycologist in the Agricultural Experiment Station, Oklahoma A & M College, has been appointee professor of botany at the University of Nebraska, and mycologist in the Department of Plant Pathology of the Agricultural Experiment Station.

Nicholas Polunin, Oxford University graduate and research fellow, has been appointed Macdonald professor of botany, McGill University, to succeed **George W. Scarth**, who has retired.

Ernest H. Ward, formerly professor of psychology, Wittenberg College, Springfield, Ohio, has joined the Los Angeles staff of Rohrer, Hibler & Replogle.

Gleb Krotkov, professor of biology, Queen's University, Kingston, Ontario, is spending his sabbatical leave at the University of California, Berkeley, where he is doing research in carbohydrate metabolism in plants. Mrs. Krotkov is occupying a temporary instructorship in mathematics at Berkeley.

Jessie L. King, chairman, Department of Physiology and Hygiene, Goucher College, Baltimore, retired in June. Dr. King is succeeded as professor of physiology and chairman of the Department by **Phoebe J. Crittenden**, who has been head of the Department of Toxicology, Merck Institute for Therapeutic Research.

John G. Kirkwood, professor of chemistry, Cornell University, has been appointed Arthur Amos Noyes professor of chemistry, California Institute of Technology, effective in September. Dr. Kirkwood is the first to be appointed to this professorship which was recently created in honor of Dr. Noyes, first chairman of the Division of Chemistry.

Arno B. Luckhardt, professor of physiology, University of Chicago, has been designated a distinguished service professor of physiology at the University.

Austin L. Rand, formerly acting chief, Division of Biology, National Museum of Canada, Ottawa, has been appointed curator of Birds at the Chicago Natural History Museum. Dr. Rand assumed his duties there July 7.

H. W. Straley, III, consultant in geology and geophysics, Worthington Consulting Service, since 1940, has been appointed valuation engineer in charge of geological, geophysical, and mining research, World Bank, Washington, D. C.

Jiles W. Haney, chairman, Department of Mechanical Engineering, University of Nebraska, since 1926, will retire as professor emeritus on September 1. **Niles H. Barnard**, formerly associate professor of mechanical engineering at the University, has been named acting chairman.

H. B. H. Cooper, chemical engineer, Calco Chemical Division, American Cyanamid Company, has been named new head of the Department of Chemical and Mining Engineering, Iowa State College, and will assume his new duties early this fall. **O. R. Sweeney**, head of the Department since 1920, will devote his time to research in the Engineering Experiment Station and to teaching in the Department.

Leonard S. Kogan, Psychology Department, University of Rochester, has been appointed assistant director, Institute of Welfare Research, Community Service Society of New York.

P. L. Magill, who has been associated with the DuPont Company for a number of years, has been appointed to the staff of the Stanford Research Institute, where he will direct some of the work in chemistry and chemical engineering.

Visitors to U. S.

Mme. Dobrovolskaia - Zavadskaia, Curie Institute, Paris, plans to attend the Fourth International Cancer Research Congress, St. Louis, Missouri, September 2–7. After the Congress she plans to devote some time to lecturing and conducting scientific discussions on problems connected with "Life and Death Phenomena in Cancerous Cells" and "Possible Role of Some Intermediary Metabolites in Pathology." While in the United States her address will be: 2242 Washington Street, San Francisco, California.

Pei-sung Tang, National Tsing Hua University, Peiking, China, wishes to confer with Chinese graduate students in biology, agriculture, biochemistry, and agronomy with a view to possible appointments in China. Dr. Tang will be in this country approximately from August 1 to August 15. Anyone wishing to confer with Dr. Tang is asked to write to him in care of the China Institute, New York City, before August 1.

Members of the South African Council for Scientific and Industrial Research scheduled to visit this country include: J. N. van Niekerk, of the National Physical Laboratory, who arrived July 14; W. S. Rapson, director, National Chemical Laboratory, arriving August 9; E. P. Carman, also of the Chemical Laboratory, arriving August 9; and W. J. Lutjeharms, professor of botany, University College of the Orange Free State, who is traveling on a grant from the Council, arriving sometime in August.

Grants and Awards

Charles Allen Thomas, executive vice-president and technical director, Monsanto Chemical Company, was the recipient of the medal given by the Industrial Research Institute, Inc., of New York City, for "inspiring leadership in the development of the American research system and for the participation thus in the American chemical enterprise." The medal was presented by Herbert W. Graham, senior past president of the Institute, at the annual meeting held June 5 in Swampscott, Massachusetts.

Lawrence H. Bailey, chief engineer, F. J. Stokes Machine Company, Philadelphia, received the annual medal of the Stevens Institute of Technology, June 4, at the third annual medal lecture sponsored by the Powder Metallurgy Laboratory of the Institute. The medal was awarded in recognition of his outstanding achievement in the field of powder metallurgy.

The University of Illinois is to receive $87,850 in Federal Government grants for research and training in the field of psychology. The grants include

$32,000 from the Navy for research in aviation psychology; $4,000 from the U. S. Public Health Service for fellowships, and $7,250 for additional staff; and $44,000 from the Veterans Administration, including income provided by provisions of the G. I. Bill for training in clinical psychology.

The Association for Advancement of Research on Multiple Sclerosis, Inc., has recently made a first grant of $64,350 for specialized research on multiple sclerosis. The three years of research provided for will be under the direction of Elvin A. Kabat, assistant professor of bacteriology, Columbia University. The major part of the project in research in the study of allergies in connection with multiple sclerosis will be conducted at the Columbia University College of Physicians and Surgeons and at the Neurological Institute of New York.

Fellowships

The Arctic Institute of North America is offering two Research Fellowships of $2,000 each for scientific work in the North American Arctic and Subarctic during 1948. Research must include field investigations either in Alaska, northern Canada, Labrador, Newfoundland, or Greenland. The Fellowships are open to anyone who has demonstrated his ability to carry out research work of superior quality in some field of science. Applications must be received by November 1, 1947. Forms may be obtained from The Arctic Institute of North America, 805 Sherbrooke Street West, Montreal, Canada.

The University of Nebraska Foundation has announced the establishment of a geology fellowship by the Shell Oil Company Fellowship Committee of New York City. The fellowship carries a stipend of $1,200 yearly, tuition and fees, and $300 to cover costs of materials and equipment. Recipients will be selected by the chairman of the Department of Geology, with the approval of the dean of the Graduate College.

Colleges and Universities

The University of Michigan has announced the establishment of several distinguished professorships. Among those appointed to these posts were: Werner E. Bachmann, Moses Gomberg professor of chemistry; George G. Brown, Edward DeMille Campbell professor of chemical engineering; Thomas Francis, Jr., Henry Sewall professor of public health; Howard B. Lewis, John Jacob Abel professor of biological chemistry; Dewitt H. Parker, Robert Mark Wenley professor of philosophy; and George E. Uhlenbeck, Henry Smith Carhart professor of physics.

The University of Toledo has announced the establishment of a four-year undergraduate program in glass technology leading to the degree of Bachelor of Engineering. The new program, sheduled to start in September, will be administered by the University's College of Engineering. Clarence L. Babcock, Research Division, Owens-Illinois Glass Company, will have charge of the initial course in glass technology. Further information may be obtained from Walter V. Burg, Department of Chemical Engineering, University of Toledo, Toledo, Ohio.

The Case Institute of Technology has announced the following promotions: Erwin F. Shrader, Department of Physics, to associate professor; Charles S. Smith, Department of Physics, to associate professor; Wiliam A. Lynam, Department of Mechanical Engineering, to associate professor; and Hugh Winn, Department of Chemical Engineering, to assistant professor.

The former University of Newark is now merged with the State University of New Jersey, maintained by the Trustees of Rutgers University. Herbert P. Woodward, formerly professor of geology and acting dean, University of Newark, is now dean, Newark College of Arts and Sciences, Rutgers University; Carl A. Olson, formerly professor of chemistry, is director, Division of Natural Sciences; and John Keosian, formerly associate professor of biology, has been promoted to professor of biology, Newark College of Arts and Sciences.

The University of Chicago has begun construction of a $1,250,000 ion accelerator building to house a 100,000,000-volt betatron, the University's cyclotron, and a new cyclotron of the most modern construction. The laboratory will be used primarily for researches in nuclear physics and radiochemistry conducted by the Institute for Nuclear Studies. Facilities for medical research with high-energy positive ions and gamma rays will be included and used by the Institute of Radiobiology and Biophysics and the Division of Roentgenology of the Department of Medicine in their programs. In this new building, which will be ready for occupancy in the spring, 98 University scientists will conduct basic researches.

Washington Square College, New York University, has announced the following promotions in the Department of Biology: Morris H. Harnly and Douglas A. Marsland to full professor; Albert S. Gordon, Milan J. Kopac, and Alexander Sandow to associate professor; and Savino D'Angelo to assistant professor.

Newly appointed faculty members of the University of Utah School of Medicine include: Emil G. Holmstrom, formerly associate professor in the Department of Obstetrics and Gynecology, as professor and head of the Department to succeed C. E. McLennan, who will become chairman of the Department of Obstetrics and Gynecology at Stanford University; Thomas Dougherty, formerly of Yale University, as professor in the Department of Anatomy; and William Moretz, formerly of Rochester University, as assistant professor in the Department of Surgery, to replace Randolph Shields, who recently left for China.

Swarthmore College has announced the following appointments in the Department of Zoology: Launce J. Flemister, research associate, Sharp & Dohme, Inc., as assistant professor; Jae L. Littrell and Norman A. Meinkoth, Department of Zoology, University of Illinois, as instructors; and Harald Erikson and Valentine Furst, University of Oslo, as research associates.

The Ohio State University Research Foundation has announced the signing of 15 new contracts totaling $428,171 for scientific studies to be conducted at the University for government agencies and industrial firms. Ten of the projects will be carried out for the Army Air Force's Air Materiel Command, the Office of Naval Research, the Cleveland Ordnance District, and the Army Engineer Board, Fort Belvoir, Virginia. Research contracts for the five industrial firms total $107,830. Research for the projects will be conducted in the fields of fuels, antibiotics, low-temperature research, ceramics and photogrammetry, radio antennae, infrared radiation, aircraft structure design, fungicides and herbicides, poultry husbandry, and criteria for the selection of personnel for positions of responsibility.

Industrial Laboratories

The Sterling-Winthrop Research Institute, a division of Sterling Drug, Inc., will have within a year a new $3,000,000 chemical and biological research laboratory at East Greenbush, New York, near Rensselaer, as the result of an agreement, announced July 12, between Sterling and the Mutual Life Insurance Company of New York. The latter will buy the tract of land from Sterling, finançe the construction, and lease the development to Sterling for a 30-year term. Research in the new laboratory will be extended to include "penicillin-like compounds and derivatives, antibiotics, organometallic compounds, sulfa drugs, antimalarials, veterinary products, barbiturates, amino acids, diagnostic agents, streptomycin, and other therapeutic preparations." In the field of tropical medicine, special emphasis will be placed on diseases prevalent in Latin America and the Near East. In addition, research will be undertaken in packaged medicines, fine chemicals, pigments, and dyes.

Eli Lilly and Company announces the appointment to its staff of Joseph Peter Gibbons, Jr., and Darrel O. Neidigh, Jr., both recent graduates of Purdue University.

The Carpenter Steel Company, Reading, Pennsylvania, has announced the appointment of Berton H. DeLong as vice-president and technical director. George B. Luerssen, assistant chief metallurgist, will become chief metallurgist.

Meetings

Brookhaven National Laboratory has arranged several informal conferences on nonrestricted material for August and early September. The dates have been selected to coincide with the visits at Brookhaven of scientists actively interested in the general topics which follow: I. Theory of Nuclear Forces: August 25–29, "Phenomenological Description of Nuclear Structure"; September 2–5, "Nuclear Energy Levels"; September 8–12, "Meson Theory of Nuclear Forces," "Production of Mesons and Protons"; II. Particle Physics: Throughout August, "Cosmic Rays: Composition of Cosmic Rays; Interaction of Mesons With Nuclei; Experimental Techniques"; and "Nuclear Spins and Moments; Interactions Between Nuclear Particles"; III. Instruments of Nuclear Science: August 11-September 12, "Super High-Voltage Accelerators, Theory of Accelerators, Analysis of Power Requirements, Detailed Design Considerations, Uses of High-Energy Particles"; and August 14–15, "Short Pulse Techniques and High-Speed Counters, Crystal Counters, Multipliers and Secondary Emission Phenomena, Cerenkov Counters, Broad Band Amplifiers, High-Speed Coincidence Techniques, Fast Geiger Counters." Information concerning transportation facilities and accommodations may be obtained from Miss Ellen Matteson, Brookhaven National Laboratory, P. O. Box 150, Patchogue, Long Island, New York.

The American Oil Chemists' Society will hold its annual fall meeting at the Edgewater Beach Hotel, Chicago, October 20–22. G. A. Crapple, Wilson and Company, Chicago, is general chairman, and Howard C. Black, Swift and Company, Chicago, is program chairman in charge of technical papers.

Recent Deaths

Grinnell Jones, 63, professor of chemistry, Harvard University, died June 23 at Cambridge Hospital.

Franklin Sherman, 69, head, Department of Entomology and Zoology, Clemson College, since 1925, died of a heart attack June 23.

Frank Clifford Whitmore, 59, research professor of organic chemistry, and dean, School of Chemistry and Physics, Pennsylvania State College, died suddenly, June 24, at his home in State College.

The South African Council for Scientific and Industrial Research has appointed a committee headed by S. H. Haughton, director, South African Geological Survey, to consider how best to organize a marine expedition which would seek to find more living Coelacanthid Fish like that found in the South African waters off East London at the end of 1938, and also to explore and accumulate data in various fields of science in the relatively poorly-known region of the Mozambique Channel. All societies, institutions, and individuals interested in this project are requested to communicate with J. L. B. Smith, Rhodes University College, Grahamstown, South Africa.

The Veterans Administration reference exhibit of prosthetic devices, completed after more than a year's work, was opened to the public on July 16. The exhibit contains approximately 1,000 items, including practically every available known type of device which may aid the physically handicapped. The permanent exhibit may be seen in Room 890, Veterans Administration Building, Vermont and H Streets, N. W., Washington, D. C., 10 A.M. to 4 P.M. Mondays through Fridays.

According to the Swedish-International Press Bureau, the unusual village of Vallhagar, which dates from the middle of the Iron Age and which is located on Gotland Island in the Baltic Sea, will be excavated this summer by about 70 archaeologists from Sweden, Norway, Denmark, Finland, Iceland, and England, who will be aided by geologists, botanists, osteologists, Swedish Air Force photographers, and mine-clearance troops. The object of the excavations is to make a detailed investigation of the settlement in order to determine its design and character. Excavations are expected to be completed by the end of September, and the results will be published jointly by the participating scientists.

The American Society for Research in Psychosomatic Problems has announced the appointment of a new Board of Editors for its journal, *Psychosomatic Medicine*. Carl Binger, psychiatrist, and formerly associate professor, Columbia University, is editor-in-chief. He will be assisted by Franz Alexander, Dana W. Atchley, Walter Bauer, George E. Daniels, Hallowell Davis, David M. Levy, Howard S. Liddell, Milton J. E. Senn, John C. Whitehorn, and Harold G. Wolff.

The U. S. Civil Service Commission has announced an examination for filling Geologist positions at salaries ranging from $4,149 to $7,102 a year. Vacancies are located in Washington, D. C., and vicinity in various Federal agencies, and throughout the United States in the Departments of Agriculture and Interior. Competitors for these positions will not be required to take a written test. To qualify, they must have completed either a four-year college course leading to a Bachelor's degree in geology, or a time-equivalent combination of study in geology and technical experience. In addition, they must have had professional experience in geology. Graduate study may be substituted for a part of the required experience.

Further information and application forms may be obtained at most post offices, from Civil Service regional offices, and from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted in the Commission's Washington Office until further notice, but persons interested in being considered for positions which will be filled immediately should apply by August 15, 1947.

Make Plans for—

American Mathematical Society, First Annual Symposium in Applied Mathematics, August 2–4, Brown University, Providence, Rhode Island.

American Veterinary Medical Association, August 18–21, Cincinnati, Ohio.

New England Association of Chemistry Teachers, 9th Summer Conference, August 18–23, Wellesley College, Wellesley, Massachusetts.

American Pharmaceutical Association, August 24, Milwaukee, Wisconsin.

American Society of Mammalogists, August 24–27, Higgins Lake, Michigan.

Americal Institute of Electrical Engineers, Pacific General Meeting, August 26–29, San Diego, California.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS

by Readers

So much valuable material is included in Robert M. Salter's paper on "World Soil and Fertilizer Resources" (*Science*, May 23, p. 533) that criticism would seem carping were it not that the treatment of the problem is dangerously misleading. It manages to pile up on both the Scylla and Charybdis what the general semanticists call elementalism and identification (Alfred Korzybski. *Science and sanity*, 1933).

It is elementalistic in its isolated discussion of soils, and of fertilizers, which are without meaning, in the world food complex, except as components of the total environment. It overlooks our profound scientific ignorance of how to cope with tropical environments, where only an insignificant amount of research has been carried on. It disregards the illiteracy rate (often 100 per cent) of tropical peoples—and what might be called the ecological illiteracy everywhere of leaders, including legalistic- and "economy"-minded legislative bodies. It begs the question of whether terror-ridden bureaucracies will be able to cope with wind erosion on the chernozem soils of Central Asia. It ignores the instability and corruption of many governments, which seem to exist primarily to line their own pockets.

What of disturbed hydrologic regimes, with their sequelae of floods, drought, falling water-tables, erosion, that have effectively removed from potential circulation millions of acres in Asia, Africa, and South America? What of the burning, overgrazing, overcropping, and deforestation that have made Africa moribund (Jean-Paul Harroy. *Afrique, terre qui meurt*. Brussels: Marcel Hayez, 1944)? What of the folkways of Asiatic and African primitives and American pressure groups that measure their wealth in destructive numbers of cattle rather than long-time yields? What of the plague of shifting agriculture that, under increased population pressures, every year sends more millions of tons of soil down the world's rivers, especially those of the tropics? What of the need to resettle hundreds of millions of people already on the land, to give them a decent living standard, and halt erosion? Of what use are millions of tons of fertilizer to India, where 60 per cent of the population has an *annual* per-capita income of $9.30 (S. Chandrasekhar. *India's population*, 1946)? How available are the soils of the tropics, when those who work them face almost certain early death from malaria, dysentery, schistosomiasis, sleeping sickness, and a number of other ills, the control of which is inordinately expensive? What of land tenure systems, tenantry, the colonial and American industrial attitude toward the land, which operates in terms of *this year's* profits? All these factors, it should be borne in mind, are interrelated in a dynamic complex in which it is rare that one does not have an influence on all, or most of, the others.

The paper further suffers from identification of U. S. conditions with those of the rest of the world—it has been done in Iowa; therefore, it can be done in Albania. I have never been in Albania, but I have traveled in many other countries; most of them are decades, perhaps centuries, behind the United States in land-use techniques. Not, of course, that we are sitting pretty. We are still losing the battle of soil conservation. We continue to go into the red, from the forest point of view. It is touch-and-go whether our western ranges can be saved from the sheep and cattle men. Many of our rivers have been turned into open sewers. Even so, there are few countries outside western Europe that are not far worse off than we.

Meanwhile, the world population is daily increasing at the rate of 50,000 empty stomachs. According to our notions, they should be filled three times a day. It is pleasant to think of 1,300,000,000 available acres and x million tons of fertilizer with which to do it. Unfortunately, for practical purposes, these are as unavailable to hundreds of millions of the earth's people as the gold at the end of the rainbow. And because of man's unintelligent waste of the soil he is using, and his irresponsible breeding, the marginal lands remaining every year become more marginal.

The problem *can* be solved, but not by resting on a downy bed of false optimism. (WILLIAM VOGT, *2101 New Hampshire Avenue, N.W., Washington, D. C.*)

I agree entirely with Dr. Yerkes (*Science*, May 2, p. 461) in his defense of the scientific status of psychology and the social studies and in his statement that "the scientific method can be applied to all natural *phenomena*" (italics mine); but I think his attack on the *Endeavour* article, as quoted, somewhat confuses the issue. That science can, with sufficient knowledge of the data, predict "whether a picture will have an aesthetic appeal" as a matter of psychological fact to this or that type of observer I do not doubt for a moment; but as to whether the picture *ought* to call forth a favorable aesthetic response, whether it is *deserving* of such a response, science can say nothing; and I think this is really what the author of the *Endeavour* article is chiefly concerned in conveying to his readers. Science is limited to a consideration of what phenomena *are*, but, regarding what *ought* to be, it can say nothing. In other words, all phenomena have a nonphenomenal aspect which scientific method cannot touch, and the values of goodness and beauty to which the author of the article under consideration refers belong to this extrascientific realm. (JARED S. MOORE, *Western Reserve University, Cleveland, Ohio.*)

Alfred E. Emerson has recently pointed out (*Sci. Mon.*, 1947, 64, 343) that human society is largely governed, not by physiological processes (such as are the inherited determinants of activity in a termite society), but by a symbolism that has to be learned. Mathematics, which Bridgman has said *is* a human invention, is the most significant element in this learning. It can be said to have created science and its results in the industrial revolution that has pyramided the human population of the earth. (See Karl Sax. *Sci. Mon.*, 1944, 58, 66-71.)

Modern society is therefore mathematically conditioned from top to bottom. Nothing that is not mechanical, *i.e.* nothing that does not conform to Lord Kelvin's definition of science as a knowledge arising from being able to "measure what you are speaking about and express it in numbers," can have any bearing on solving social problems. In none of its forms is life mechanistic. But human society, because it is *not* a "living structure," is mechanistic in the character of what Yerkes (*Science*, May 2, p. 462) notes as "this vast array of recent discovery and of technical applications in various branches of human engineering."

Our social problems are therefore coldly intellectual in the detached manner of science. They belong, I suspect, to the cerebrospinal system which is the directive, not the impulsive, autonomic system, with hormones conditioning its reactions. They deal with, but are not themselves, natural phenomena. They are ethical in character, *i.e.* they concern right and wrong as affected by truth and falsehood in what Northrop (*The meeting of East and West.* New York: Macmillan, 1946. P. 442 ff.) calls "epistemic correlations." They are problems, not in observing behavior as if it were conditioned by inherited "ecto-hormones" (Emerson), but in conditioning behavior by institutions which are the locus of the "free will" thus taken over from the individual as he is constrained, by their logic or illogic, into rational or irrational behavior. It is thus not true that (Emerson, *op. cit.*, p. 344) "the problems of human society are much closer to those being solved by the biologists than they are to those of astronomy or nuclear physics."

Whatever psychology may have accomplished or failed to accomplish is irrelevant socially if it is dealing with natural phenomena under hereditary stimuli. Therefore, a "lack of faith in the applicability of scientific procedures to psychological and social phenomena" is warranted (*contra* Yerkes, *op. cit.*, p. 462), because social phenomena are not natural, *i.e.* they are not psychological, but are intellectual. And intellectual controls are not real, natural phenomena but are ideal, purposive inventions, with social objectives, which may or may not be rational, *i.e.* suited to their purpose.

Any organism can make a bad, even a fatal, choice. But when "all we like sheep have gone astray," we have done it by *thinking* blindly *before* acting blindly, in concert. So, human cooperation is not necessarily beneficent, as is implied by current diplomatic palaver. An irrationally conditioned society cannot promote beneficent cooperation merely because its individuals or leaders wish to do so. Their logical, not their psychological, directives determine the nature of events; and the events do not contain their own causation as in natural phenomena. If they did, prayerful thinking would be quite in order and would be correctly fatalistic.

The historical materialism that is shaping the *ir*rationale of the current institutional developments of "socialism" is irrational in its interpretations because it believes, as does Dr. Yerkes (*op. cit.*, p. 461) that "the scientific method can be applied to all natural phenomena" and that social phenomena are natural in their sequences. That this is not true is the central theme presented by Northrop (*op. cit.*, p. 255 ff.) in protesting against the culturalistic fallacy of trying to derive a normative theory from the factual theory of social "science."

Thus, the "hosts of us who are now classified as scientists" may well be "self-deceived workers who, unlike our physical science colleagues, are denied access to the truth concerning the natural phenomena which particularly interest us" (Yerkes, *op. cit.*, p. 462)—because they simply are not natural phenomena! The social psychologist, arbitrarily placing all events in the natural field, destroys the realistic epistemological dualism in philosophy upon which an effectively integrated science depends.

"Culturology" (see L. White. *J. Wash. Acad. Sci.*, 1947, 37, 181-210) may well serve as an escape from the egocentric predicament of the personal, psychological approach to social problems; but it seems certain that its rationale can only be, not that of a new empiricism, but simply the timeless metaphysical disciplines of philosophy and logic. We shall come to see mathematics as a cultural artifact or "human invention." As such, it represents a social device for choosing, not ends, but means; nor is it an "illusion of omnipotence" to recognize it as the ultimate in social recourses. Its logic is, indeed, compelling; but who would say that the laws of reason are as unbreakable in human society as are the laws of motion in the "infinite meadows of heaven"? Truth is not a robot! (ALDEN A. A. POTTER, *R.F.D. 3, Bethesda, Maryland.*)

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TECHNICAL PAPERS

Reproductive Cycles of Five Species of Texas Centrarchids[1]

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During 1941 and early 1942 data were taken from approximately 2,350 centrarchids from a group of 5 artificial lakes located in eastern Texas. The lakes, owned by a private hunting and fishing club, ranged in size from 75 to 650 acres. The species studied were the largemouthed black bass, *Huro salmoides* (Lacépède); the white crappie, *Pomoxis annularis* Rafinesque; the black crappie, *Pomoxis nigro-maculatus* (LeSueur); the bluegill, *Lepomis macrochirus* Rafinesque; and the redear sunfish, *Lepomis microlophus* (Günther). In this report attention is given to the reproductive cycles of the 5 species between March 1941 and March 1942. Restrictions on travel caused by the war terminated the research program at that time.

TABLE 1

OVARY WEIGHT/BODY WEIGHT RATIOS × 10^3 (GRAMS) FOR 5 SPECIES OF CENTRARCHIDS IN TEXAS DURING 1941 AND EARLY 1942

Date	Species				
	Large-mouthed bass	White crappie	Black crappie	Bluegill	Redear
Mar. 23	32.9 (9)*	56.2 (35)	61.0 (11)	— —	27.5 (4)
Apr. 6	33.8 (13)	29.3 (7)	44.3 (4)	30.3 (3)	62.6 (15)
" 20	30.8 (4)	25.2 (5)	14.3 (3)	41.0 (3)	69.1 (13)
May 10	9.7 (13)	5.9 (15)	5.5 (8)	28.3 (8)	26.8 (9)
" 31	3.8 (4)	— —	4.3 (7)	30.9 (8)	21.3 (7)
June 21	4.2 (9)	2.8 (10)	3.3 (4)	22.4 (5)	17.9 (18)
July 19	3.5 (4)	3.0 (1)	2.6 (3)	19.7 (13)	5.8 (13)
Aug. 29	2.4 (16)	2.5 (5)	2.8 (20)	14.6 (20)	5.0 (13)
Oct. 5	3.6 (7)	4.5 (9)	4.2 (21)	— —	— —
" 31	1.9 (2)	— —	— —	— —	— —
Nov. 18	2.4 (11)	— —	— —	— —	— —
Jan. 24	11.5 (26)	17.3 (14)	25.5 (15)	9.0 (2)	11.1 (11)
Mar. 1	8.3 (2)	— —	— —	14.4 (3)	14.4 (4)
" 18	21.5 (2)	28.1 (2)	40.7 (1)	5.6 (2)	11.6 (4)
" 28	38.6 (12)	— —	— —	22.8 (4)	49.5 (11)

* Figures in parentheses indicate frequencies.

All the data upon which this study is based were taken from fish caught by the club members and included material essential to the study of food habits and age and rate-of-growth determinations, as well as the reproductive organs. The viscera were preserved in a 5 per cent solution of formaldehyde. At a later time the ovaries were weighed to the nearest .1 gram, and the ratio of ovary weight/body weight multiplied by 10^3 was determined for 525 individuals. These ratios and the frequencies arranged according to the date of collection are presented in Table 1.

When presented graphically, as in Fig. 1, several interesting points are brought out with respect to the reproductive cycles of the species considered. If it is assumed that the period covered by the decline in the slope of the curve represents the spawning period for each species, considerable variation in the length of the spawning periods is evident. The bluegill population, for example, spawned well into September after reaching a peak of gonadal development around April 20. The largemouthed black bass, on the other hand, spawned from the middle of April until the end of May. The white and black crappie populations spawned from the latter part of March until the early part of May, while the redear sunfish held an intermediate position among the populations, the spawning period extending from around April 20 to the end of July. Expressed in terms of spawning intensity, it is also evident that in 1941 the maximum decline in the value of the ovary weight/body weight ratio for the bass, redear sunfish, and bluegill populations occurred approximately one month after the crappie populations showed their maximum decline in the value of the ratio. The mean air temperatures during the months of March and April in this locality were 53° and 67°F., respectively.

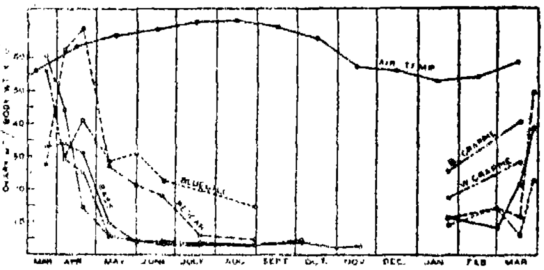

FIG. 1

Fig. 1 also indicates that the ovary weight/body weight ratio remains at a low level for several months, followed by a gradual and then abrupt increase in value. For example, in the largemouthed black bass population the ratio dropped from 30.8 in late April to 3.8 in the latter part of May and remained approximately at this level until the middle of November, beyond which point no data were available for 1941. The next collection, however, showed an increase in the ratio from the November low of 2.4 to the January level of 11.5, and an abrupt increase occurred during the month of March, when a high of 38.6 was attained. This abruptness in gonadal development was also evident in the redear sunfish population in both 1941 and 1942. The collections of January and March in 1942 also show the crappie populations to be ahead of the other species in ovary development. The mean monthly air temperatures for the first three months of 1942 were 46°, 49°, and 58° F., respectively.

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[1] Contribution No. 14, Department of Biological Science, Michigan State College. The fishery program of which this study is a part was made possible by the cooperation of the Koon Kreek Klub and North Texas State College. The author also acknowledges the assistance of R. Bagwell and J. M. Faggard.

Studies such as this, if carried on over an extended period of time to determine the degree of variation which undoubtedly exists in the length of the spawning periods, the periods of maximum decline in the ovary weight/body weight ratios, and the causes of such variation, would assist materially in providing a more scientific basis for the establishment of "closed seasons" if the evidence justified restrictive fishing measures.

Intercellular Surface Phagocytosis[1]

W. Barry Wood, Jr., and Mary Ruth Smith

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Pathogenic microorganisms with protective capsules are ordinarily considered resistant to phagocytosis unless previously opsonized by specific antibody (*1*). Evidence has recently been presented that both encapsulated pneumococci (*3*, *4*) and Friedlander's bacilli (*2*) are readily phagocyted in the absence of antibody by a mechanism referred to as surface phagocytosis. Direct visualization of this nonantibody form of phagocytosis in the lung has shown that the leucocytes phagocyte the encapsulated bacteria by trapping them against the surface of the tissue. Once taken into the cytoplasm of the phagocytic cells, the bacteria are rapidly killed (*2*, *4*).

During experiments in which surface phagocytosis of Friedlander's bacilli in lung sections was being observed directly, phagocytosis was occasionally noted at some distance from the alveolar walls. The phagocytosis occurred whenever bacilli happened to get caught between the surfaces of two or more colliding leucocytes. On such occasions the surface of the adjacent leucocyte appeared to act in the same capacity as did the alveolar wall in the previously described form of surface phagocytosis. When the number of leucocytes in the phagocytic mixture was increased, the intercellular surface phagocytosis was noted frequently (see Fig. 1).

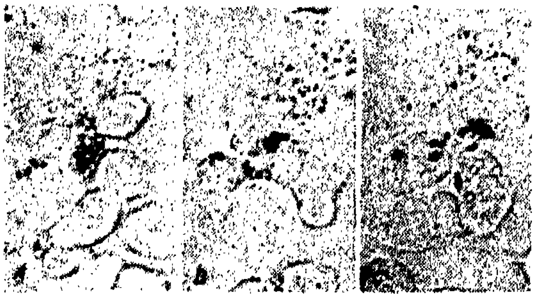

Fig. 1. Intercellular surface phagocytosis: (A) Leucocytes surrounding a group of encapsulated Friedlander's bacilli in a medium devoid of antibody (time, 2:10 P.M.); (B) Leucocytes have closed in on the bacilli so that they are trapped between the surfaces of the phagocytic cells (time, 2:23 P.M.); (C) The trapped bacilli have been phagocyted and can be seen in the cytoplasm of three of the leucocytes (time, 2:40 P.M.).

From these direct observations it appeared likely that intercellular surface phagocytosis would result whenever the concentration of leucocytes became such that the encapsulated bacteria could be readily trapped between two or more cells. To test this hypothesis, the following experiment was performed:

Friedlander's bacilli harvested from 2 ml. of a 4-hour broth culture (*2*) were suspended in gelatin-Locke's solution along with washed leucocytes obtained from the peritoneal cavities of 4 rats previously injected with starch aleuronat (*2*). The leucocyte-bacillus mixture was then concentrated by centrifugation (2,000 r.p.m. for 5 minutes), and as much supernatant fluid as possible was removed with a pipette and discarded. The concentrated mixture, which now contained a minimum of free fluid, was incubated for 30 minutes at 37° C., and smears of the mixture were stained with methylene blue. Examination of the smears revealed marked phagocytosis of the Friedlander's bacilli, whereas in control experiments, in which the leucocyte-bacillus mixture was not concentrated, little or no phagocytosis resulted.

Similar results were obtained with *Pneumococcus* Type I (A5 strain), *Pneumococcus* Type III (A66 strain)[2], and a mouse-virulent strain of *Staphylococcus aureus* (strain 235). Young cultures of each of these organisms resisted phagocytosis when incubated with leucocytes in dilute solution.

Intercellular surface phagocytosis of a number of pathogenic encapsulated organisms was thus brought about merely by diminishing the amount of fluid in the bacteria-leucocyte mixtures. Although the capsules protect the organisms against phagocytosis when the bacteria are floating freely in a fluid medium, they fail to protect them against surface phagocytosis when the latter occurs on a tissue surface or as a result of the intercellular mechanism just described. As previously stated, bacteria ingested by the nonantibody mechanism of surface phagocytosis are promptly killed by the phagocytic cells (*2*, *4*).

The significance of intercellular surface phagocytosis in the mechanism of recovery in pneumococcal and Friedlander's bacillus pneumonias is indicated by the following considerations:

Although the earliest reaction of the lung to acute bacterial infection is the outpouring of edema fluid into the infected alveoli, this first stage is promptly followed by a rapid accumulation of leucocytes at the site of infection. The amount of edema fluid in the alveoli and bronchi diminishes, and the number of leucocytes present increases until the phagocytes are so numerous that they form the solid mass of cells characteristic of the advanced stages of pulmonary consolidation. Such a concentration of phagocytic cells eventually makes it virtually impossible for bacteria in the consolidated areas to escape surface phagocytosis. Those organisms that are not trapped against the tissue surfaces of the alveoli and bronchi are eventually phagocyted by being pinned between the surfaces of two or more of the crowded leucocytes. Thus, leucocytes in the lung may, through these two forms of surface phagocytosis, bring about destruction of even the most virulent encapsulated organisms, in the complete absence of immune bodies.

Conclusions: Encapsulated bacteria are phagocyted by leucocytes in the absence of opsonins, not only by being trapped against tissue surfaces but also by being caught between the surfaces of the phagocytic cells. Because large num-

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[1] These studies were supported by the Commonwealth Fund.

[2] Kindly supplied by Colin M. MacLeod, of New York University.

bers of leucocytes accumulate in the lung during acute bacterial pneumonia, it is concluded that intercellular surface phagocytosis causes the destruction of many of the invading organisms, particularly during chemotherapy in the early stages of the disease when specific antibodies are not present to opsonize the bacteria.

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Use of 2,4-D Weed Killers on Woody Weeds in Cuba

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The problem of eradication of woody perennial weeds is much more serious in the tropics than in temperate zones. In Cuba the most serious weed is the legume *Dichrostachys nutans*, known as *Aroma marabu*. Since this plant regenerates vigorously from cut stumps, its eradication by continued cutting is almost impossible. In experiments carried out at the Atkins Garden and Research Laboratory of Harvard University, at Soledad, Cuba, several preparations and methods of spraying of 2,4-D have been tested on plots of large, well-established plants from cut stumps. Although delayed regeneration is still not entirely excluded, the following approximate figures for apparent kills in 4 weeks have been obtained:

TABLE 1

Treatment	Per cent apparently killed	Per cent probably alive
1. 2,4-D sodium salt, 0.2%	18	21
2. The same applied twice, 5 days apart	76	8
3. The same, 0.3%, applied once	62	8
4. The same, 0.3%, plus Carbowax 1500, 0.5%, applied once	87	1
5. 2,4-D ester, 0.3%, applied once	94	4

Since the plants die slowly, the percentage kill increases steadily with time, and a number of plants have to be classed as doubtful for a month or more after treatment. On balance, treatment No. 4 was considered the most effective, although No. 5 gave the most rapid defoliation. The volumes used were about 100 gallons/acre.

Plants in the shade were only slightly less affected than those in the sun. Spraying on the underside of the leaves did not increase the toxicity.

Another troublesome plant, *Comocladia dentata* (Guao), having a toxic action on the skin like that of poison ivy, was also studied. In this case the ester preparation ("Weedone") was definitely more effective than either the salt or the free acid, probably because of its better adherence to the vertical glossy leaves, from which aqueous sprays ran off rapidly. A concentration of 0.3 per cent gave about a 75 per cent kill as determined 6 weeks after spraying.

These experiments, which give promise of possible reclamation of land up to now considered virtually unavailable, are being continued.

Note on the Theory of Radiation-induced Lethals in *Drosophila*

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A rather complete theory of induced lethals in *Drosophila* which was proposed by Lea and Catcheside (*5*) has met with objections in private discussions. As this theory is now embodied in a comprehensive book (*4*) (reviewed in *Science*, April 25, p. 454), it may be advisable to publish some comments on the matter.

The frequency of x-ray–induced, sex-linked recessive lethals in *Drosophila* is experimentally known to be accurately proportional to the x-ray dose, at least up to about 5,000 r. The presence among these lethals of a large number which are located at points affected by chromosomal rearrangements creates a well-known difficulty for the interpretation of the dependence of frequency on dose (*2*). If it is simply assumed that this fraction of lethals is a by-product of the rearrangements, the total frequency of recessive lethals should increase faster than in proportion to the dose. Lea and Catcheside made the alternate assumption that the recessive lethals and the rearrangements result independently from a single type of primary effect. This primary lesion, the frequency of which is assumed to be proportional to the dose, may or may not, according to chance, lead to a recessive lethal and/or to a rearrangement. Such a common ancestry accounts for the observed coincidence of recessive lethals with rearrangements. It must also cause, however, a parallel frequent coincidence between the recessive lethals and those rearrangements (e.g. dicentrics) which are unviable ("dominant lethals") and thus escape detection. The latter rearrangements thus make an inroad in the observable recessive lethals, which should become increasingly important with increasing dosage; consequently, the frequency of recessives should increase slower than in proportion to the dose.

This nonlinear effect, embodied in Lea and Catcheside's detailed theory, leads to a very significant discrepancy between this theory and the experimental data. The authors merely discount the discrepancy because they reckon on having overestimated it by an undetermined amount (*5*). It is proposed here to give a minimum estimate of the importance of this discrepancy, using general arguments.

Lea and Catcheside classify the recessive lethals as class *A* (associated with no rearrangement), class *B* (associated with a minute rearrangement), and class *C* (associated with a viable gross rearrangement). This latter kind of rearrangement will be called *VGR*. We shall also consider class *D* lethals, *i.e.* those associated with an unviable gross rearrangement (*UGR*).

The various symbols will be used to indicate the corresponding frequencies, but it should be noted that the frequencies of *C*'s and *VGR*'s *among viable sperms* are, respectively, $C/(1-LGR)$ and $VGR/(1-LGR)$. The Lea-Catcheside assumption means that $A + B + C + D$ is proportional to the x-ray dose; the frequency of recessive lethals among viable sperms is $A + B + C/(1 - LGR)$. The departure of these two expressions from one another, which is a measure of the nonlinear effect, can be expressed as:

$$\begin{aligned} &\frac{A+B+C+D}{A+B+C/(1-LGR)} - 1 \\ &= \frac{D - C\,LGR/(1-LGR)}{A+B+C/(1-LGR)} \qquad (1) \\ &= \frac{C/(1-LGR)}{A+B+C/(1-LGR)} \\ &\quad [(D/C)(1-LGR) - LGR]. \end{aligned}$$

The first factor in the last expression is the fraction of C's among the observable lethals. The bracketed factor can be reduced by algebraic manipulation to a form involving only the experimentally known frequency $VGR/(1 - LGR)$ and factors on which predictions can be made. These are $p = LGR/VGR$ and

$q = \frac{D}{LGR}/\frac{C}{VGR}$. The quantity (1) can then be written as

$$p\frac{q - VGR/(1-LGR)}{1+p\,VGR/(1-LGR)} \quad \frac{C/(1-LGR)}{A+B+C/(1-LGR)}. \qquad (2)$$

As stated above, $\frac{C/(1-LGR)}{A+B+C/(1-LGR)}$ and $VGR/(1-LGR)$ are observable quantities which, at 3,000 r, amount to about 1/3 and 1/5, respectively (*4*). The factor $p = LGR/VGR$ would be 1 if every rearrangement involved only two breaks; since this is not so, p will in general be larger than 1 (*2*) and might be even as large as 2 at 3,000 r. The factor $q = \frac{D}{LGR}/\frac{C}{VGR}$ would also be 1 if VGR's and LGR's had the same chance of being associated with a sex-linked recessive lethal; actually, $q > 1$, since the LGR's are expected to have more breaks, on the average, than the VGR's. The quantity (2) is thus certainly larger than the value found by taking $p = q = 1$, which at 3,000 r would be about 2/9. For $p = 2$, $q = 1$, it would be 8/21.

Therefore, it can be stated that the nonlinear effect amounts to at least 20–25 per cent at 3,000 r. On the assumption that the C lethals are by-products of VGR's the nonlinear effect is $(A + B)/(A + B + C) - 1 = C/(A + B + C) = 1/3$—that is, possibly a somewhat larger one. The Lea-Catcheside theory may thus reduce the nonlinear effect by a factor which amounts to 1.5 at most. The remaining nonlinear effect is probably significantly at variance with the set of experimental data discussed by them. At any rate, it seems quite unlikely that an effect of such quantitative importance could have failed to be detected in all the extensive studies on this subject by so many different workers.

It may well be that the Lea-Catcheside concept of the recessive lethals, as manifestations of the same type of primary lesion which leads to the observable chromosomal breaks, is essentially correct. But the process of x-ray–induced breakage and recombination in *Drosophila* has thus far defied not only a quantitative but even any comprehensive qualitative analysis (*2*, *3*). This difficulty may well prevent for the time being any satisfactory account of the relationship between recessive lethals and rearrangements and of their dose frequency relationships. This same difficulty, incidentally, seems to put the Lea-Catcheside detailed calculation of the dose-frequency relationship for dominant lethals (*4*, *5*) on a very doubtful ground, although there seems to be no difficulty with the qualitative understanding of this relationship.

A final remark may be added concerning the recessive lethals (B) associated with minute rearrangements. Lea suggests that the deficiencies involving several salivary chromosome bands are due to separate breakage processes caused by a single ionizing particle, in analogy to the mechanism which he successfully proposed for *Tradescantia*. However, the frequent occurrence of spontaneous lethals involving deficiency of several bands (*1*) suggests that such deficiencies are the outcome of a single primary, probably much more closely localized, lesion. The larger deficiencies up to about 50 bands, and the corresponding minute inversions, are generally accepted to be due to the same mechanism as the VGR's (*4*). Accordingly, a substantial fraction of the class B recessive lethals should have been transferred to class C for the purpose of the calculation carried out in this paper; this would have made the nonlinear effect appear even more important.

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Cosmic Radiocarbon and Natural Radioactivity of Living Matter

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In view of the discovery of radiocarbon produced by cosmic radiation (*1*), it becomes of interest to compare its effect in living matter with that due to the older sources of activity, such as radium and its decay products, or potassium, and to the action of cosmic rays. Since data on humans are most readily available to us, we will limit ourselves here to a comparison *in man*.

This comparison can be made on various bases, such as range, ionizing power, or total energy of the particles. The range varies from the extremely small range of α-particles up to the whole length of the human body for cosmic rays. The ionizing power per unit length varies in reverse order and decreases from the higher value for α-particles to cosmic rays.

As radiochemists, it seems to us that the simplest basis of comparison would be the number of disintegrating atoms (or rays) per human being and per unit time. Table 1 shows a preliminary comparison based on an estimated average body weight of 80 kg.

TABLE 1

Element	Wt. % in human body	Total element in body (grams)	Literature source	Specific act. dis./min. and 1 gram element	Nature of emitted particle	Dis./min. and man
Potassium	0.35	280	Sherman (*2*)	1,340	β	380,000
Carbon	18.0	14,400	"	10.5	β	150,000
Radium	$\simeq 10^{-11}$	$\simeq 8\cdot 10^{-9}$	Vernadsky (*3*)	$2.22\cdot 10^{12}$	α	$\simeq$18,000
	$\simeq 5\cdot 10^{-12}$	$\simeq 4\cdot 10^{-9}$	Evans*	"	α	$\simeq$9,000

*Private communication from Robley D. Evans, Massachusetts Institute of Technology

The intensity of cosmic radiation at sea level corresponds to approximately 1 meson per minute and per cm.[2] Therefore, depending on whether the human being is in a standing or lying position, *i.e.* on his "cross section," the number of penetrating particles ranges approximately between 1,500 and 7,500 per man and per minute.

Thus, comparing these data, we see that cosmic radiocarbon occupies second place. Based on number of disintegrations, it is a little below half of potassium, but very much above radium and other natural radioelements. Only because of the low *specific* activity of carbon has it escaped detection so far. We believe that the biological significance of the radioactivity of carbon in living matter cannot be evaluated in physical terms alone; specific biological and biochemical factors may also play a role. It will be up to future research to establish these.

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IN THE LABORATORY

Bioassay by Direct Potency Estimation[1]

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Two main approaches are used to determine the potency (Py) of a drug, *i.e.* the ratio between threshold equipotent doses of the standard (S) and the unknown drug (U) (Py = S/U). One procedure uses the median effective doses (ED_{50}) of standard and unknown as expressions for S and U, respectively, and operates by determining these two values in separate populations of test animals. Another assay method compares the standard and the unknown drug on the same test object or animal. Usually the aim is first to find in each of various test individuals a pair of equipotent doses of the standard and the unknown ($s^1, u^1; s^2, u^2; s^3, u^3$; etc.), each such dose level complying with a set end-point in a critical range of effect, and then to obtain from these dose pairs a number (N) of equality statements (E), each E representing an estimate of the intraindividual potency in the respective test object ($E^1 = s^1/u^1$; $E^2 = s^2/u^2$; $E^3 = s^3/u^3$; etc.). Py is then defined as the average of the intraindividual potencies $\left(\frac{\Sigma E}{N}\right)$. Thus, in the latter method, potency is evaluated directly on the basis of intraindividual potency statements and not by a preceding determination of S and U which is characteristic of the former method. The former may therefore be called an indirect, and the latter a direct, method of potency evaluation.

The indirect method does not need any special biostatistical basis. Determinations of ED_{50} have long been placed upon an elaborate mathematical basis, and their adoption has satisfied all biostatistical requirements of such a method. On the other hand, the direct method has two major shortcomings: It lacks a rigorous biostatistical means for defining the significance of the result, and its purpose is accomplished in an uneconomical trial-and-error procedure. Prior to arriving at the respective doses s and u, one has to perform tests with a varying number of doses either higher (h) or lower (l) than s or u, respectively, *i.e.* with doses h_s and l_s of the standard and doses h_u and l_u of the unknown. The data from all these preliminary tests are ultimately discarded as being "aberrant."

Only in one variant of direct procedure, the "method of approximation" (*2*), are these aberrant doses utilized for obtaining a rough estimation of the significance of the result. They are paired, both mutually and with the respective s and u values, to form additional statements pertinent to potency, namely, statements H of maximum potency (signifying $Py < H$), expressed by the ratios h_s/l_u, s/l_u and h_s/u, and statements L of minimum potency ($Py > L$), expressed by the ratios l_s/h_u, s/h_u and l_s/u. All these H and L values are then arranged in

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numerical progression; they approximate the true Py value from opposite directions, and the range of overlap indicates the deviation from the true Py. For example, the series of experimental H, L, and E data in columns 1 to 3 of Table 1 would indicate a mean Py of 27.2 and a deviation of ±16.5 (or ±45 per cent) from a midvalue of 36.5.

TABLE 1

POTENCY ESTIMATION OF THE 3-(1-METHYL-OCTYL) ANALOG OF SYNTHETIC TETRAHYDROCANNABINOL*

1	2	3	4	5	6	7	8	9	10
H	E	L	n_H	n_E	n_L	M Py of group	$n_H+n_E+n_L$	λ_H	Probit
60									
60			3	0	0				
60						56.0	6	5.5/6	6.37
52	52		2	1	0				
52									
50	50								
50	50		2	2	0				
48									
48			3	0	0				
48						46.8	13	9/13	5.50
46	46								
	46		1	2	0				
	42	42							
	42		0	2	1				
40	40	40	1	1	2				
		40							
	36.4		0	1	0				
34		34	1	0	2				
		34							
33.6			1	0	0	32.9	17	9/17	5.15
33.4	33.4		1	1	0				
		33.2	0	0	1				
32	32	32	2	1	1				
32									
30.8			1	0	0				
	30	30	0	2	1				
	30								
	27	27	0	1	1				
		25.2	0	0	1	26.2	10	2/10	4.16
	24	24	0	1	1				
		23.4	0	0	1				
		21.2	0	0	1				
	20	20							
	20	20							
		20	0	2	5				
		20							
		20				18.4	11	1/11	3.51
		18	0	0	2				
		18							
		16	0	0	2				
		16							

$N = 57$

$2s' = 50.8 - 23.6 = 27.2$

$\sqrt{2N'} = 10.68$

$Py = 35.0$

$s.e. = \frac{2s'}{\sqrt{2N'}} = \pm 2.54$

* Test function: ataxia activity in calibrated dogs. Standard: synthetic tetrahydrocannabinol.

Even in this variant, the direct bioassay procedure is mathematically unsatisfactory, and preference is given whenever possible to the indirect method. Yet, of necessity, the direct method is employed whenever the test objects (e.g. isolated organs, monkeys, dogs) are from populations with excessive interindividual variation or whenever intraindividual comparison is the procedure of choice. This signifies a wide field of actual use of, and too great a need for, procedures for direct Py estimation to dismiss them summarily as devoid of mathematical background (*1*) rather than to furnish constructive assistance for their improvement.

Obviously, conventional biostatistical methods can readily be applied to the data from such intraindividual dose comparisons. The totality of data on maximum, intraindividual, and minimum potency, collected for the above procedure of approximation, furnishes useful information, and the alignment of such data in a series of approximation (compare Table 1, columns 1 to 3) offers an appropriate starting point for a statistical likelihood solution.

The likelihood λ_H that any of the tentative potencies expressed by H or L values or both is greater than the true Py varies along the approximation series. If the total range is subdivided into appropriate groups of tentative potency, the likelihood that the mean Py of the individual group ($M\ Py = \frac{\Sigma H+\Sigma E+\Sigma L}{n_H+n_E+n_L}$) is greater than the true potency value Py is expressed by the proportion between the number of H statements (n_H) and the total number of potency statements ($n_H+n_E+n_L$) available for the group. The ambiguous E values must be assumed to express an equal likelihood that the median Py value of the group is too high and that it is too low. Accordingly, the final likelihood for a group is $\lambda_H = \frac{n_H+n_E/2}{n_H+n_E+n_L}$. The λ_H values coordinated to each M Py are calculated and converted into probits by reference to a probit table or to a table of integral of the normal probability curve. The probits, when plotted against the logarithm of their M Py, approximate a straight line. The abscissa value of the intersection of this line with the probit ordinate of 5 is an estimate of the true potency Py having a λ_H of 0.5. The standard error (s.e.) may also be determined from the same graph according to the formulation $s.e. = \frac{2s'}{\sqrt{2N'}}$, where $2s'$ is the difference between the abscissa values of the intersections of the experimental line with the probit ordinates of 4 and 6, and where N' is the number of potency statements within the range of probits 3.5 and 6.5.

The total procedure is illustrated by the example in Table 1, in which the biostatistical evaluation is shown applied, in parallel with the "method of approximation," to the same experimental data. Fisher's probit table and a graphical interpolation procedure comparable to that of Miller and Tainter (*3*) were employed after calculation of the M Py and λ_H values. The Py value obtained differs greatly from that computed by the "method of approximation," and the s.e. is much smaller than the range of deviation in the series of approximation. It should also be mentioned that the good agreement between the roughly computed midvalue of Py and the mathematically estimated Py value is merely accidental and that frequently there is considerable divergence between the results of the approximation method and those of the method herein outlined.

The suggested procedure for direct potency estimation has been found expedient in numerous bioassay problems, e.g. in assaying spasmolytic and antihistaminic drugs in isolated strips of surviving gut; laxatives in terms of stool-softening in rhesus monkeys; marihuana-active substances in terms of ataxia in dogs; and sympathomimetic agents in terms of ability to elevate the cat's blood pressure. The task of assaying biological activity by intraindividual comparison is not limited to drugs, but arises in many cases in which the potency of commensurable stimuli—agents, factors, etc.—has to be correlated numerically on the basis of a common response. It is believed that the principles of this procedure may be serviceable in various disciplines other than pharmacology.

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Identification and Chromatography of Androgens as Their 2,4-Dinitrophenylhydrazones

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Frequent use is made of 2,4-dinitrophenylhydrazine (DNPH) for the characterization of aldehydes and ketones, and the chromatographic adsorption of a number of the hydrazones of DNPH is described by Strain (*2*). However, the reagent does not appear to have been widely used in the study of steroid ketones. Veitch and Milone (*3*) have published a method for the estimation of estrone as the 2,4-dinitrophenylhydrazone, but their procedures seem not to have been applied to androgens. These studies suggested the possibility of using DNPH for the isolation and characterization of the constituents of commercial androgen preparations. In 1941 Coffman (*1*) reported the preparation of several androgen esters of p-phenylazobenzoic acid and was able to resolve mixtures of several of these colored esters chromatographically. In dealing with commercial products, however, this type of derivative could not be expected to distinguish between free and esterified androgenic steroids.

This paper constitutes a preliminary report of the preparation and properties of the DNP-hydrazones of testosterone, testosterone propionate, methyl testosterone, androsterone, and dehydroisoandrosterone. First attempts to prepare the hydrazone of one of these androgens (testosterone propionate) directly in an oil solution indicate that such a procedure is possible and may be developed into a useful analytical method. Over-all yields of about 60 per cent have been obtained to date. Details will be published as soon as the techniques are perfected.

The chromatographic separation of mixtures of some of these hydrazones has been accomplished, which indicates the possible application of the reagent to urinary extracts of ketosteroids for investigations in androgen metabolism.

A 10- to 15-mg. sample of each androgen, dissolved in 1-2 cc. of ethanol, was allowed to react with a 10 per cent excess of reagent (prepared by adding 2 or 3 drops of concentrated hydrochloric acid to the calculated amount of the free base dissolved in a minimum of hot alcohol), and the mixture boiled for about 2 minutes. Frequently the hydrazone precipitated immediately from the hot solution, but if it did not, water was added to the point of cloudiness. On cooling, precipitation occurred. The precipitate was filtered off, washed with water to remove hydrochloric acid, and dried *in vacuo* over phosphorus pentoxide. After solution in benzene, it was adsorbed on activated alumina (Aluminum Ore Company, Grade F 20, minus 80 mesh), and the chromatogram developed with 10-15 per cent chloroform in benzene. On this adsorbent the bands formed may be brown, orange, or yellow, depending upon the individual compound and to some extent on the developing mixture. Following development, either the column was extruded and cut or, if extrusion proved difficult, the colored zones were dug out with a spatula. The hydrazones of the androgens prepared to date are all readily soluble in benzene and chloroform, moderately so in hot alcohol, but only slightly soluble in ligroin.

After elution with chloroform and filtration, the solvent was removed by distillation under reduced pressure and the hydrazone recrystallized from hot aqueous ethanol to constant melting point. Crystallization from benzene-ligroin pairs produced no change in melting point, but the color of the crystals was usually different from that seen when alcohol was employed. Yields of 95-100 per cent of theory are readily obtained.

TABLE 1

Androgen	M.P.*	Crystalline form and color	N found (%)	N calculated (%)
Testosterone	202.5°-203.5°	Red needles	11.62	11.96
Testosterone propionate	209.9°-210.5°	" "	10.67	10.68
Methyl testosterone	221.5°-223.5°	Orange "	11.41	11.86
Androsterone	232.5°-234°	Yellow "	11.68	11.91
Dehydroisoandrosterone	241°-242°	Yellow micro needles in thick mat	—	—

* Melting points were determined with an aluminum block apparatus calibrated by means of the U.S.P. melting-point reference standards, but are not otherwise corrected.

Table 1 lists the data for the androgen hydrazones prepared to date.

When a mixture of the hydrazones of testosterone and testosterone propionate was subjected to chromatographic adsorption, as described above, the constituents were readily separated and recovered in yields of 97 per cent and 91 per cent respectively, the fractions being identified by melting-point determination after recrystallization. The derivative of testosterone was adsorbed at the top of the column and that of the propionate below.

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Book Reviews

Veterinary bacteriology. (3rd ed.) Ival Arthur Merchant. Ames, Ia: Iowa State College Press, 1946. Pp. viii + 683. (Illustrated.) $7.00.

The third edition of Merchant's *Veterinary bacteriology* will be welcomed by teachers, students, and practitioners. Practically all the bacteria which cause diseases in domestic animals are discussed. In addition, several which affect only man, such as *Eberthella typhosa*, are included. The text is well written, thoroughly comprehensive, and most valuable for instructional and reference purposes. It should be on the shelf of all practitioners and in the libraries of veterinary students. The illustrations are well chosen and typography is good.

Sections on the general biology of microorganisms, infection, resistance, and immunity, and discussions on pathogenic yeast, molds, and viruses, with chapters on the spirochetes, rickettsiae, bacteriophage, and the pleuropneumonia group, are welcome additions, as is the chapter on antibiotics. Reference to *Proteus ammoniae*, *Hemophilus bovis*, and *Clostridium sordellii* is a valuable addition.

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Rehabilitation through better nutrition. Tom D. Spies. Philadelphia-London: W. B. Saunders, 1947. Pp. iv + 94. (Illustrated.) $4.00.

Experiences with folic acid. Tom D. Spies. Chicago: Year Book Publishers, 1947. Pp. 110. (Illustrated.) $3.75.

Both of these small books are essentially reports of clinical researches in nutrition conducted at the Hillman Hospital, Birmingham, Alabama. The monograph on folic acid is an excellent résumé of studies of this important element of the vitamin B complex and the role which folic acid plays in hematopoiesis. Evidence is presented supporting the contention that folic acid is as effective as is liver extract in stimulating blood regeneration in patients with pernicious anemia, nutritional macrocytic anemia, sprue, and pellagra. However, folic acid does not protect the patient from the central and peripheral changes in the nervous system so commonly present in pernicious anemia. Furthermore, large amounts are necessary to produce as satisfactory a hematopoietic response as that obtained with liver extracts, which contain but minute quantities of folic acid. It is highly probable that other elements, as yet undiscovered, are involved in primary pernicious anemia. The volume contains a carefully selected bibliography of some 80 titles.

Rehabilitation through better nutrition does not live up to its overly ambitious title. This 94-page monograph is essentially a report of the studies on the many grossly undernourished patients seen in the nutrition clinic: florid pellagra, sprue, scurvy, and deficiency anemias respond brilliantly to adequate nutritional therapy. The limitations of vitamin and mineral supplemental feeding are clearly stated; when prolonged deficiency has existed and the reserves have been depleted for some time, certain irreversible effects result which are not amenable to vitamin or mineral therapy. A thorough discussion of the variability in requirements points out the invalidity of the assumption that the minimum food requirements are constant. Requirements are affected by race, age, environment, health, work, and the like.

Enthusiasm is as necessary for scientific research and the advance of knowledge as are the vitamins to normal growth. But when enthusiasm leads to such asymmetry of thinking that perspective is lost, it ceases to be wholly desirable. The glitter of the brilliant discoveries concerning the vitamins, trace minerals, hormones, enzymes, and the like has blinded too many students of nutritional problems. The recent literature on nutrition is filled with the erroneous assumption that malnutrition means only deficiency in nutrition. Malnutrition is bad nutrition and includes the effects of excesses as well. Obesity is just as much a nutritional disease as pellagra or rickets or scurvy. As a menace to national health and therefore a problem of social medicine, obesity is more significant than undernutrition, despite the asymmetric emphasis of gross deficiency states in the South. We should not ignore the fact that 28 per cent of the population of the United States are 10 per cent or more *over* their optimum weight, whereas only 12.8 per cent are 10 per cent or more *under* their mean normal weight. However, there is no mention whatever of rehabilitation of the obese in Dr. Spies's monograph. Nor is there mention of the importance of water as a nutritional necessity. If the title were "Therapy of Gross Nutritional Deficiencies," the reviewer would have nothing but praise for this scholarly, scientific report. As it is, one fears that certain uncritical readers will feel that the rules formulated therein are the answer to all of mankind's ills.

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Animal nutrition. (2nd ed.) Leonard A. Maynard. New York-London: McGraw-Hill, 1947. Pp. xviii + 494. (Illustrated.) $5.00.

The second edition of this text presents the chemistry and physiology of nutrition with application to the feeding of farm animals in much the same sequence and style as the first.

During the 9 years since the first edition of this book appeared, significant advances have been made. Of particular importance have been the advances in the field of the vitamins, enzymes, amino acids, and minerals. The author, in bringing the work up to date, has extensively revised many sections of the text and made deletions of less important material, thereby keeping the book close to its original size.

The book is well written in an interesting, readable, and understandable style. The literature citations and reference lists are exceptionally well chosen and should prove particularly helpful to the student.

As before, this book fills a niche in the literature for instructional purposes where suitable texts are not numerous.

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The Detection of Incipient Army Criminals

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THE SELECTIVE SERVICE SYSTEM IN operation during the late war delivered selectees to the Armed Forces Induction Stations, where they were examined to determine whether they met the War Department standards for induction. Failure of a selectee to meet prescribed standards resulted in rejection. Such action was based essentially on the assumption that unqualified selectees could not serve a useful purpose in the Armed Forces, but that qualified selectees could.

The standards were roughly of three kinds: physical, mental, and moral. Examinations in all three fields were at first made by medical doctors, but as personnel needs became more acute and finer discriminations became necessary, nonpsychiatric mental examinations became the specific responsibility of professional psychologists. Responsibility for moral examinations, however, was never clearly delegated to specialists in this field.

As the war progressed it appeared that induction station screening procedures were, in general, fairly satisfactory in the physical and mental fields; but the Army prison population increased rapidly. Overcrowding in disciplinary barracks and rehabilitation centers became worse and worse, despite the regularly increasing number of such installations—a state of affairs indicating that screening procedures to prevent the induction of these men were not entirely satisfactory.

The situation was further complicated by a War Department provision that Selective Service registrants with other than honorable discharges from the Armed Forces, registrants currently undergoing confinement, and registrants with prison records might be inducted after approval of the Service Commander had been secured. In the 7th Service Command the responsibility for granting this approval was delegated to the Personnel Division in the Service Command headquarters.

The difficulty was most acute in connection with applications for induction from registrants currently undergoing confinement. At first the short, running case histories accompanying these applications were evaluated subjectively and applications either approved or disapproved accordingly. These case histories varied widely in completeness, and some were much more persuasive than others. This element of persuasiveness was one with which it was particularly difficult to deal. Finally, under special War Department authority, the development of improved procedures was undertaken.

A Preliminary Procedure

A search of the literature revealed that several studies had been made by sociologists in predicting success in the probation and parole of civilian prisoners. From published data a Case History Check Sheet was constructed for preliminary use in evaluating the case histories submitted with applications from corrective and penal institutions. By means of this sheet and the accompanying parole violation expectancy table, a running case history could be evaluated quantitatively. It was assumed that a potential parole violator would also be a poor Army risk. This device was found to be a great improvement over the unaided subjective evaluations made previously; but inasmuch as it was based on data from a civilian population and its use rested on an unverified assumption, and because it was not well adapted to routine induction station use, steps were taken to develop a still more satisfactory procedure.

In using the Check Sheet it was noted that half or more of the items included pertained to circumstances and conditions of life *prior* to imprisonment. Since these items had been shown to have a significant predictive value in relation to parole violation *after* a term in prison, a more comprehensive list of such items could be employed in the contemplated device. Eventually a psychological rather than a sociological procedure was decided upon, *i.e.* judgment was to be based upon the reactions of the selectee himself made on the spot. Analysis of the psychological principles involved indicated that nothing would be lost and much might be gained by using items having a sociological connotation.

Psychological Principles Involved

Maladjusted, antisocial behavior in an adult is learned behavior, constitutionally permitted but not so caused. Such behavior was learned and became habitual through the mechanism of trial-and-error responses to recurrent, emotionally charged, stimulus situations. In the 18–20 years leading into adulthood, behavior patterns become firmly established and cannot be shed at will; they must be unlearned. Unlearning and relearning may require the presence of remedial situations as potent and as long standing as were the originals.

With respect to these circumstances of life, variation must be considered. Furthermore, concomitant variation

From an address delivered at the annual meeting of the American Educational Research Association, Atlantic City, New Jersey, March 3, 1947.

among the following factors is probable: (a) occurrence of unfavorable stimulating situations up to a given date, (b) seriousness and extent of maladjustment, (c) chances for prompt imprisonment, and (d) chances for prompt rehabilitation or spontaneous readjustment. If concomitant variation among these factors is a fact, status in one can be estimated when it is known in another. For example, a measure of (a) can be used to estimate (c). This particular relationship was relied upon in developing the improved technique. More specifically stated, it was assumed that selectees arriving at an induction station with a self-related history of experiences characteristic of Army prisoners, but not of normal operative personnel, may be expected to become prisoners promptly. Inasmuch as they would then serve no useful purpose, rejection would be the indicated action.

Developmental Technique

The technique employed to develop and calibrate this measuring instrument was relatively simple. From a survey of the literature a comprehensive list of descriptive items were assembled and arranged in multiple-response, single-choice form. The following examples illustrate the form of these items:

1. **The number of members in my family that have been sent to a mental hospital, prison, or other institution are—**
   a. none
   b. one
   c. two
   d. three or more
2. In the past 5 years I have been in trouble from fighting—
   a. not once
   b. once
   c. twice
   d. three or more times
3. As a child my parents were—
   a. always very strict with me
   b. usually very strict with me
   c. seldom very strict with me
   d. never very strict with me

Available evidence indicated that each of the items so assembled was significant in relation to social adjustment or maladjustment.

Responses to items in this experimental form, called the Biographical Case History, were secured from two contrasting criterion groups of Army personnel. The first consisted of 1,177 general court martial prisoners, inmates of the U. S. Disciplinary Barracks at Fort Leavenworth, Kansas, and the Rehabilitation Center at Camp Phillips, Kansas. The second group consisted of 1,050 enlisted men from the operative personnel of reception centers in the 7th Service Command.

The number making each response, in each criterion group, was determined. These numbers were converted to proportions, and, by comparing proportions of each criterion group, item by item, the 67 items showing the largest differences were selected to constitute the final form. Among these 67 items the smallest difference between proportions was .141. The standard error of this difference was .020, the critical ratio thus being about 7. Each of the remaining 66 items had even greater discriminating power. As usually considered, this is internal evidence of validity.

External evidence was also obtained. From the proportion of cases in the two criterion groups making each reply, a scoring key was so arranged that a credit of one point was allowed for each reply characteristic of normal soldiers but not of prisoners. A group of 1,366 prisoners (1,117 general and 249 garrison) was separated into two divisions, one consisting of 580 first offenders and the other of 786 recidivists. Statistics from these two divisions are given in Table 1. From these statistics the difference between the two means and its standard error are found to be 6.43 and .48, respectively, giving a critical ratio of about 13.

TABLE 1

MEASUREMENT STATISTICS ON ARMY PRISONERS SEPARATED INTO TWO DIVISIONS

Group	Cases		Mean score	S.D.
	No.	Proportion		
First offenders	580	.424	34.45	8.83
Recidivists	786	.576	28.02	8.81
Total	1,366	1.000	30.75	9.37

It is assumed that maladjustment varies from little or none, through an amount causing the first offense, into a greater amount causing repeated offenses. The two divisions of prisoners therefore represent two segments on a continuum. If it is further assumed that the distribution of maladjustment in the prison population approximates the normal curve, then obtained measures of maladjustment can be correlated with the criterion, using the formula for biserial r. Believing that these two assumptions are warranted, such a coefficient was derived from the data given above. The correlation is .428, its standard error, .029, and the critical ratio, almost 15.

This is a rigorous test of validity, because the range of maladjustment in the prison population is restricted to a small fraction of the range existing in the total population. Subsequent information indicates that the spread between the means in the normal and prison population is about equal to the spread in school achievement between the means of three school grades. Furthermore, the instrument must measure (as it does) over a total range approximately equivalent to an 8- or 9-grade range in school achievement. Therefore, if the validity coefficient in the restricted range were corrected for the total range within which the instrument must be used, it would be unusually high.

CALIBRATION

Several questions had to be answered before standards could be constructed with dispatch. One question was: Must second and independent samples be drawn for calibration purposes? To answer this question, second, independent, but smaller samples were actually drawn, and means and standard deviations from the two samples were compared to see whether they differed significantly. The statistics are given in Table 2. Both critical ratios pertaining to the means are less than 2.0, and both pertaining to the standard deviations are less than 1.0. Thus, by the usual criterion for the significance of differences, it appeared unnecessary to draw second independent samples for standardization purposes.

TABLE 2

MEASUREMENT STATISTICS ON TWO SAMPLES EACH OF NORMAL OPERATIVE SOLDIERS AND IMPRISONED SOLDIERS

Item	Mean	S.D.
Operative soldiers		
Sample 1 (1,050 cases)	47.65	6.79
Sample 2 (116 cases)	48.58	6.86
Difference	0.93	0.07
Standard error of difference	0.67	0.47
Critical ratio	1.9	0.1
Imprisoned soldiers		
Sample 1 (1,177 cases)	30.24	9.30
Sample 2 (130 cases)	31.85	8.85
Difference	1.61	0.45
Standard error of difference	.82	0.58
Critical ratio	2.0−	0.8

The second question to be answered was: Do standards based on normal operative personnel in the Army apply sufficiently well to selectees arriving for induction? To answer this question, measures were secured from a cross-section sample of arriving selectees and comparison made, as before, between the means and standard deviations in the two groups (Table 3). The difference of 1.5 points between the means, although statistically significant, was considered unimportant operationally in relation to the difference of 17.4 points between the means of operative and imprisoned personnel. The standard deviations were almost identical. For calibration purposes the two samples were combined (1,581 cases).

TABLE 3

MEASUREMENT STATISTICS ON NORMAL OPERATIVE SOLDIERS AND SELECTEES

Item	Mean	S.D.
Operative soldiers (1,050 cases)	47.65	6.77
Selectees (531 cases)	46.10	6.79
Difference	1.55	0.02
Standard error of the difference	.36	.25
Critical ratio	4.3	.0+

The third question to be answered was akin to the second: Do standards based on general court martial prisoners apply sufficiently well to garrison prisoners also? Measures were secured from a group of garrison prisoners, including both the sentenced and the unsentenced, and means and standard deviations were compared as before (Table 4). Since both critical ratios are less than 3, the differences were considered insignificant, and the two samples were combined for calibration purposes. For the normal group (1,581 cases), the mean was 47.13 and the standard deviation 6.81; for the imprisoned group (1,426 cases), the values were 30.42 and 9.51, respectively.

TABLE 4

MEASUREMENT STATISTICS ON GENERAL COURT MARTIAL PRISONERS AND GARRISON PRISONERS

Item	Mean	S.D.
General prisoners (1,177 cases)	30.24	9.28
Garrison prisoners (249 cases)	31.27	10.46
Difference	1.03	1.18
Standard error of the difference	.71	.51
Critical ratio	1.5	2.3

In view of the constant military use of the term "calculated risk" and in view of the necessity for always either accepting or rejecting a selectee for induction, calibration took an unusual form. From the data given above, a pair of probabilities was derived for each possible score: (1) that a selectee would become a normal operative soldier and (2) that he would become an Army prisoner. Although these probabilities are the proportion of cases lying in the tails of the two distributions beyond a given score, the proportion in the lower end of the operative distribution and in the upper end of the prison distribution was taken. Thus, the higher the score, the greater the probability that the examinee should be classified as a prospective operative soldier and the less that he is an incipient Army criminal, and conversely.

Each pair of probabilities was further converted to a base of 1.00; that is, if the pair of chances were 16 to 16, it was considered equally appropriate to say that this represents a .50-.50 chance. Whatever pair is taken in this case, the sum is always 1.00. This is the underlying procedure followed when one has an equal admixture of successes and failures in a single normal distribution of such scores that high is predictive of success, and low of failure. In such a distribution the chances are .50-.50 at the median, .25-.75 at the upper quartile point, and .75-.25 at the lower quartile point.

With calibration in the form of paired probabilities related to two contrasting criterion groups, the critical score may always be set in accord with the amount of risk considered appropriate at the moment. Such a continuum rests squarely upon the criterion and is not merely connected with it loosely through a supplementary validity coefficient. With such a continuum the criterion becomes functional, not merely descriptive.

UTILIZATION

Records were examined concerning the use of the Biographical Case History in the 7th Service Command during the 18-month period, March 24, 1944–September 24, 1945. The records indicate that 4,278 selectees with previous criminal records were examined. Of these, 57 per cent, or 2,438 cases, were rejected for failure to meet the moral standards for induction. The average raw score for these rejects was between 33 and 34. The pair of percentages for score 34 is 92:8. That is, one could expect 92 per cent (2,243), had they been inducted, to become moral casualties and be imprisoned.

In addition to these men, 356 made application to the Service Commander for a prior moral waiver. Of these applicants, 168 were rejected. Their average raw score was 28. Reasoning as above, 99.6 per cent probably would have become moral casualties had they been inducted. Adding these to the previous figure gives a total of 2,410 incipient Army prisoners kept by the 7th Service Command from entering the Army during this 18-month period.

Case records of moral casualties in Army prisons indicate that most of their stay in the Army represents a loss. It has been estimated that the cost of each psychiatric casualty, from inception to cure or death, in World War I averaged $30,000. Many of the elements of cost in moral casualties are the same as in psychiatric casualties.

Case records of general prisoners show rather uniformly a series of minor offenses leading eventually to a serious offense and a general court martial. If these men get into theaters of operation, they cannot be depended upon to accomplish a mission. Their failure causes the destruction and waste of material and equipment and the loss of other lives. Thus, the money spent on them routinely for induction, transportation, food, clothing, shelter, medical care, training, and equipment is sheer loss. An estimate of $1,000 each from this source is considered extremely conservative. To this must be added the cost of their apprehension, transportation, trial, confinement, and all other matters incidental to their offenses. A cost estimate of $1,000 each from this source is also considered very conservative.

Even so, at $2,000 each, the estimated money saving to the Army through the use of the Biographical Case History over an 18-month period in only one of the nine service areas, is almost $5,000,000. If the average cost of a moral casualty turns out to be equal to the cost of a psychiatric casualty ($30,000 instead of $2,000 each), this estimate would rise to over $67,000,000.

IMPLICATIONS

Dealing scientifically with the problem of crime resulted in monetary benefits to the Armed Forces. Similar benefits may be secured in civil life. Business and industry, for example, would find it equally profitable to avoid the employment of incipient criminals. The Biographical Case History used in induction stations can be converted to a quantified personal history sheet and used in employment offices. With it, psychologists can select morally qualified personnel for business and industry, taking whatever chances are deemed appropriate under the circumstances. Furthermore, through use of appropriate criterion groups and statistical procedures an instrument may be devised for detecting persons predisposed toward a particular type of crime. Certain types of crime are crucial in connection with certain jobs. It is quite undesirable, for example, to hire incipient embezzlers as cashiers or pilferers as watchmen.

Selection of all kinds, however, is merely a procedure enabling one portion of society to avoid the cost of crime. If crime exists, so does its cost. If a portion of society avoids this cost, the burden is increased for the remainder. The problem is prevention, not avoidance. But prevention is the negative side of the case. Stated positively, the problem is that of promoting moral living.

The field of morality lies in the twilight area between saintliness and crime. In the study here reported certain circumstances of living were found to be antecedent to crime. If these antecedents are removed, is crime prevented? If the antecedents of saintliness were discovered and more abundantly provided, would morality be increased? From present knowledge about cause and effect, the answer to both questions appears to be "yes." An effective program of action, therefore, would operate in two directions: (1) to eliminate circumstances of living that lead to crime and (2) to provide more abundantly those circumstances of living that lead to greater morality.

Three of the principal agencies concerned are the schools, the churches, and the social welfare agencies. With a device such as the Biographical Case History, schools can detect incipient delinquents and at the same time discover the particular patterns of living that are causing delinquency in individual cases. In cooperation with the churches and social welfare and other agencies, steps can be taken to alleviate these circumstances. Of the three agencies mentioned, however, the churches have the greatest opportunity.

The scientific method is universally applicable. It is a problem-solving procedure that may be applied in any field where problems exist. In physical science this procedure has yielded atomic energy and vastly increased the destructiveness of war. With less funds than are now spent on physical science, social science can accomplish equally great things, at greater present profit for society. If incipient criminals of lesser grade can be detected and the inciting circumstances of living removed, it should also be possible to detect incipient war criminals and remove the causes of war. Furthermore, in the continuous climate of peace that can be provided by social science, physical science can serve constructive ends unceasingly.

New Horizons in Archaeology

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THE ADVANCEMENT OF SCIENCE IN THE past century has clearly demonstrated the fact that the progress made in any one field is dependent upon that made in associated fields of study. In no instance is this more noticeable than in the field of archaeology. We all accept the fact that mathematics and geology are among the "ancients" in science, but we are apt to forget that archaeology is older than any of these. Man, with his interest in the past, has for thousands of years manifested an interest in the events and progress of those who preceded him. A close study of all of the "greats" in ancient science will reveal their interest in old remains and the lives of those who lived before them. Even among the savage tribes we find this same interest in the past. Thus, it is safe, I believe, to list anthropology among the first of the sciences to be studied.

Anthropology is a study which uses all of the sciences as tools. It is difficult to name any field of endeavor which has not been studied by the anthropologist in an attempt to reconstruct the history of mankind. Then, in turn, when the material has been evaluated, it is the chemist or metallurgist who takes the early history of his subject and uses it as a basis for later development.

The methods of the early worker in anthropology were, of necessity, crude. Unfortunately, in the case of archaeology the scientist is given but one chance. The story of man's past is written as though upon ancient parchment which crumples when exposed to the air. One careless excavation, loss of the description of a discovery, and the knowledge of that specific site is lost to the world forever. This unique position has for many years made archaeologists a clique of scientists who have not invited the eager diggings and examination of uneducated laymen. Year after year they have seen thousands of pages of history torn to bits for the price of a pretty piece of pottery or a shiny bracelet.

As the brother sciences advanced, so did the study of ancient man. The correlation of archaeology with the other sciences is now such that, to be an archaeologist, one must be, in the most general terminology, a scientist. In order to solve the mysteries of the ancient red man, for example, it has become necessary to turn to geology, botany, physics, mathematics, and numerous other disciplines. All the great archaeological advances made in America in the past century are due to the intelligent use of methods developed in other sciences.

A study of the food of the cultures of America has occupied many of the best men in that field. The association of food areas with migrations was determined and aided in the study of the problems of archaeology. The study of climates and early man by noted meteorologists has added much to our knowledge of ancient life. Studies of basketry, clothing, and ceramics have enlisted the aid of many persons not otherwise interested in archaeology and, in turn, have interested the archaeologist in subjects previously unknown to him. Art designs and early means of writing have led to very involved studies and attempts to decipher these early written languages. Remains of temples and other ruins have led the archaeologist to the architects in order that these might be reproduced intelligently and the mystery of their use solved. Early work in stone and manufacture of paints, glue, cement, maps, poisons, medicine, etc. have caused archaeologists to put down the spade and begin a study of the above subjects in order to understand their discoveries. The specific knowledge so vital to the archaeologist is that which will enable him safely to discover and remove for posterity these pages of unwritten history.

In this field more has been done in the past century than in all of the previous history of the world. Aerial photography has revealed to the student the location of numerous sites in regions before unmapped. In other regions it has revealed terrain features not noticeable from the ground. Once located, modern cameras and a professional knowledge of the subject have enabled accurate recording of the progress of the excavation with greater detail than sketching could ever afford. Application of tree-ring dating methods have been used to date numerous sites in the Southwest by study of the timbers used in ancient ruins. Mathematical and qualitative studies of pottery distribution have led to their use as a dating device. Geology has been applied to settle difficult problems of great age, possible only by knowledge of strata relations.

Following excavation of the site, by use either of the spade and brush or of more modern methods involving elaborate machinery for removal of fine sand or large quantities of dirt, much remains to be done. It is here that the numerous resources now available must be applied. Special devices for photographing the interior of pottery vessels have been placed in operation. Methods

From a paper presented before Section H, AAAS Boston Meeting, December 26, 1946. The statistical analysis described by the author was conducted with the aid of grants from the American Philosophical Society and the Washington Academy of Science.

for the removal of layers of paint on walls of dwellings, used over a period of years, have been helpful in preserving what would have formerly been destroyed. In the laboratory, ancient seeds and fruits have been studied, chemicals and paints analyzed, and pottery mixtures reproduced.

Although plans are being formulated for exploration of sea floors in search of lost cities and the use of diving apparatus has been demonstrated in Mexico, the new horizons of archaeology lie neither there nor in the unexplored countries from which we hear daily of the discovery of subhuman links. The new horizons of archaeology lie in the development of methods and practices fully applicable to all sciences. With but few exceptions the problems of archaeology are well known. We now know where the missing links should be located, the eras for which little has been found, the areas that are barren, and the material in the museums that now is of little value. As the era of large excavations for the purpose of stocking museums passes, the serious student of archaeology looks to the small sites and the ancient finds, where often little is found. It is his job to make the best utilization of the little he does find in order to rewrite as much of the story as possible.

One of the best examples of this type of material is the petroglyph or the numerous designs known as picture writing. Throughout the United States, as well as throughout the world, these designs are known. From Alaska to Mexico and from the Pacific to the Atlantic the walls of canyons are covered with the crude or elaborate pictures of the ancient American. Many of these are godlike figures towering 10 or 12 feet above the observer, while others are small designs carved on the surface of boulders in rivers in the hope of bringing added luck in fishing. Others in caves are painted in red, yellow, and blue and depict the scenes of tribal life. On numerous canyon walls as many as three or four different designs have been superimposed on others, the whole series covering a period of a thousand years. For many years, when archaeologists had great masses of material to excavate, these designs were ignored. For a while the early settlers of America thought that the designs were made by early explorers from Norway, eastern islands, or even Egypt. In some cases hundreds of books were written to describe these sites, and even duels were fought by those having different theories. As time passed and more sites were found where the only evidence of man's occupation was these strange "doodles," the archaeologists became more interested in making use of these designs as a key to the makers.

As art, pottery, and foods in different areas vary, so is there difference in designs. In some cases the simple designs, such as circles, squares, etc., were universal in their distribution. Others, however, like the quaint flute player of the Southwest, the water monster of Pennsylvania, or the masked dancers of Utah, formed a basis for constructive analysis. The material was so scattered and vast in amount that many workers became discouraged and left the task to others. With the general introduction of the method of qualitative analysis by A. L. Kroeber, of the University of California, the study of petroglyphs was approached by one of his fellow professors, Julian Steward, who in the 1930's began a qualitative analysis of the subject in an effort to make this vast amount of material available to archaeologists. By the use of some 50 typical designs ranging from simple lines to complex maps, Dr. Steward began to study the sites of California. As he had expected, the typical designs varied with geographical location, and in some cases his areas, as determined by the simple designs on canyon walls, agreed completely with those determined by the longer task of excavation and years of research. With the publication of his results the archaeologists of the United States began to dig from their files the old photographs and sketches of the petroglyphs of their respective states. Their work soon revealed, however, that in certain cases the material at hand must be handled by more definite means.

In the hope of testing a new method as well as continuing a study of petroglyphs, the author applied the statistical method in a formal manner to the same material first used by Dr. Steward. As was expected, the application of this subject proved that the correlation suspected and proved by Dr. Steward did exist and could be mathematically shown to exist. In addition, the results served to answer the questions raised by Dr. Steward's survey and revealed the usefulness of the application of statistics. In California and later in other states it has been possible to define the limit of cultural areas and in some cases to define the most important time relations—all by use of the simple designs so similar to the telephone "doodles" of today.

The application of statistics in this specific instance has been of value to the archaeologist in the study of material where such evaluation can be made. As many of the finds of the archaeologist are of this type—pottery, artifacts, and cultural traits—use of the method will lead to new and better comprehension of old data. In the museums and colleges of the United States numerous files of material are available for study in the light of new methods. When it is possible to make maximum use of all the data found at a site, from the smallest picture to the largest piece of pottery, we will be able to rewrite the story of the early American.

Although modern devices enable the archaeologist to make more comfortable expeditions and simplify the task of excavation, it is in the realm of analysis of material discovered that the new advancements will be made. Through proper use of statistical and qualitative methods all types of data, formerly discarded, may now be studied. The increased use of such methods has caused the scientist to look eagerly toward new horizons.

Association Affairs

Scientific Exhibits

The Advisory Committee for the AAAS Chicago Meeting has announced the availability of space for scientific exhibits, together with application procedures. The scientific exhibits will be housed with the technical exhibits in the Stevens Hotel, which will also serve as the main registration center for the meetings.

The Advisory Committee recommends that there be a wide variety of selected exhibits which will (1) portray scientific advances in the various fields of science; (2) show new techniques and apparatus usable in the laboratory or in classroom teaching; (3) summarize research in a given field. The Committee feels that personal demonstration is the most important single factor for a successful scientific exhibit because of the mutual benefit which accrues to the visiting scientists and the demonstrators. Originality in planning the exhibit is encouraged. Charts, drawings, transparencies, specimens, and other materials can be shown in a variety of ways, using light and color judiciously. A large expenditure of money is not necessary.

In general, the space allocated for scientific exhibits will be 6 feet deep and 10 feet wide. The Committee may at its discretion allocate a greater width than 10 feet. The exhibitors pay the expenses of preparation, transportation, and installation of their exhibits. Special construction in the booth, extra tables, chairs, or other furniture can be obtained at regular rates from the decorating firm. Application forms for scientific exhibit space may be obtained from: Theo. J. Christensen, Director of the International Science Exhibition, AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D. C.

Members of the Advisory Committee for the exhibition are: Robert Coghill, Abbott Research Laboratories; Gustav Egloff, Universal Oil Products Company; Ovid Eschbach, Northwestern Technological Institute; Lyman W. Higgins, Gaertner Scientific Corporation; J. E. Hobson, Armour Research Foundation; Paul E. Klopsteg, Northwestern Technological Institute; Harvey B. Lemon, Museum of Science and Industry; and M. W. Welch, W. M. Welch Manufacturing Company.

AAAS-George Westinghouse Science Writing Awards

The Managing Committee of the AAAS-George Westinghouse Science Writing Awards has announced the names of the judges for the current year. The Judging Committee will select one newspaperman and one magazine writer to receive a $1,000 prize each for superior science writing for the lay public during the period October 1, 1946–September 30, 1947. Members of the Committee are: Morris Meister, principal, Bronx High School of Science; H. L. Mencken, *Baltimore Sun* papers; Benjamin McKelway, editor, Washington *Star*; Rudolf Flesch, author and writer; Kenneth Olson, dean, Northwestern University School of Journalism; Detlev Bronk, chairman, National Research Council; Edward Weidlein, director, Mellon Institute, Pittsburgh; Edward Weeks, editor, *Atlantic Monthly*; and Clifton Fadiman, literary critic.

The prizes will be awarded at a dinner at the Stevens Hotel on December 27, during the 114th meeting of the Association.

Photography in Science Competition and Salon

Information and entry blanks for the Photography in Science Exhibition are now available for distribution to professional scientists who wish to participate. The exhibition, sponsored jointly by the Division of Graphic Arts of the Smithsonian Institution and the *Scientific Monthly*, is designed to bring together the various techniques of photography used by scientists in all fields of science, thereby extending its possibilities for development as a basic tool in research and teaching. Entries will be received in Washington from September 25 to October 15. Accepted entries will be hung in the Smithsonian Institution November 1–30 and will then be shipped to Chicago for display at the International Science Exhibition of the AAAS, December 26–31. The two divisions of the exhibition will be (1) black-and-white and (2) color. No entry fee is required, nor is membership in the AAAS a requisite. Members of the Judging Committee are: Lt. Alexander J. Wedderburn, associate curator, Division of Graphic Arts, Smithsonian Institution; Ralph D. Bennett, technical director of the Navy's new ordnance laboratory at White Oak, Maryland; K. M. Endicott, U. S. Public Health Service; Eleanor Parke Custis, internationally known photographer and salon exhibitor; and A. Aubrey Bodine, associate editor of *Camera* magazine.

After the exhibition closes at Chicago it will make a tour of museums throughout the country. Arrangements have been made to ship the exhibit to the Buell Planetarium in Pittsburgh immediately after the showing in Chicago. The next stop on the tour will be the Cranbrook Institute of Science, Bloomfield Hills, Michigan.

Science Theater

Reviving a prewar custom, there will be in the general exhibition area at the Chicago Meeting a Science Theater with seating capacity for approximately 50–75 persons at a time. The Advisory Committee believes that many recent research projects have been recorded on films or slides. It is felt that visitors to the meetings and the exhibition will want to have an opportunity not only to see the specific research films but also to learn more about the techniques of this method of recording research.

Advance solicitation of films and slides indicates that enough material should be available to last during the entire period of the meetings. Scientists who have or know about films that could be used are asked to send the information to Theo. J. Christensen, AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. A complete schedule of the films to be shown will be published in *Science* and the general program.

NEWS *and Notes*

The U. S. Zoological Park, Washington, D. C., has recently placed on exhibit four rare species of mammals from a collection made in the Philippine Islands by Charles Wharton. One of the most interesting species is *Tarsius carbonarius*, from Mindanao. Although there are 9 known species ranging from the Philippines to the East Indies, the 24 tarsiers of this species are the first to be exhibited in the United States. Some of the remarkable characteristics of this primitive primate, placed phylogenetically between the lemurs and the New World monkeys, are: expanded discs on fingers; folding ears; elongated tarsus for jumping; and tail for propping the animal. The three other rare species of mammals in this collection are: the tree shrew (*Urogale everettii*); Shadenberg's giant bush-tailed cloud rat (*Crateromys shadenbergii*) from the mountain forests of Luzon; and Cuming's giant cloud rat from the same locale. The first flying lemur to be brought successfully to the United States died in New York soon after arrival. The collection also includes 3 monkey-eating eagles, 1 white-breasted sea eagle, 1 serpent eagle, pythons, and lizards.

Section I (Psychology), will hold sessions Monday and Tuesday, December 29–30, at Chicago. Members wishing to present papers should send abstracts to the secretary, Harold E. Burtt, Department of Psychology, Ohio State University, Columbus 10, Ohio. Abstracts should be in triplicate (not over 200 words) and must be received by September 15 if they are to be considered. A program committee will decide which abstracts are acceptable and will prepare the detailed program. If slides, charts, or blackboard are necessary, a statement to that effect should be made at the end of the abstract. The time required should also be specified (maximum, 15 minutes). In the case of slides, it should be specified whether they are 2 x 2 or 3¼ x 4 inches. Moving pictures will not be shown in conjunction with any paper.

About People

Viktor Hamburger, professor of zoology, and chairman, Department of Zoology, Washington University, is visiting professor of zoology, University of Chicago, during the current summer session.

George H. Harding, formerly co-director of the engineering firm, Coulson and Harding, and president and general manager, National Air Surveys, Cincinnati, Ohio, has been appointed professor in the Department of Civil Engineering, Ohio State University, effective October 1.

W. H. C. Rueggeberg, Chemical Division, Chemical Corps Technical Command, Army Chemical Center, Maryland, is visiting England, Switzerland, and Sweden on matters of interest to the Chemical Corps.

Paul B. Sawin, associate professor of biology, Brown University, has been appointed research associate of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, where he will continue his studies on the genetics of normal growth processes in the rabbit.

C. Richard Soderberg, deputy head, Department of Mechanical Engineering, Massachusetts Institute of Technology, has been appointed head of the Department.

A. E. Alexander, director, Gem Trade Laboratory, Inc., New York City, has just returned from Bahrain Island, Persian Gulf, where, at the invitation of C. Dalrymple Belgrave, C. B. E., adviser to the Bahrain Government, he investigated the genuine pearl fishing industry of the Gulf area. On his return, Dr. Alexander stopped in London to work with Basil W. Anderson, director, Precious Stone Laboratory, London Chamber of Commerce.

Pol Duwez, who has been doing research at California Institute of Technology since 1941, when he arrived from Belgium as a special Belgian-American Education Foundation student, has been appointed associate professor of mechanical engineering at the Institute.

Douglas F. Miner, formerly George Westinghouse professor of engineering, and assistant director, College of Engineering and Science, Carnegie Institute of Technology, has been appointed director, Division of Student Personnel and Welfare.

Thomas Hope Johnson, formerly associate director, Ballistics Research Laboratory, Aberdeen Proving Grounds, has been appointed head, Department of Physics, Brookhaven National Laboratory, and **Leland J. Haworth,** professor of physics, University of Illinois, has been appointed assistant director in charge of Research Projects at the Laboratory.

Henry Plenk, formerly of the University of Chicago Clinics and the Evanston Hospital Association, has been appointed assistant professor, Department of Radiology, University of Utah Medical School.

W. C. Coker, Kenan professor and emeritus head, Department of Botany, University of North Carolina, and **Ivey Foreman Lewis,** dean, College of Arts and Sciences, University of Virginia, were awarded honorary D. Sc. degrees at the June commencement of the University of North Carolina.

Julian F. Smith, formerly editor, Institute of Textile Technology, Charlottesville, Virginia, is now a scientist on the staff of the Office of Naval Research, Washington, D. C.

Grants and Awards

Leon S. Stone, Bronson professor of comparative anatomy, Yale University, received the Doyne Memorial Medal at the recent annual meeting of the Oxford Ophthalmological Society, Keble College, Oxford, England. The award is in recognition of his work on retinal regeneration and vision experiments in transplanted eyes.

Percy L. Julian, formerly head, Department of Chemistry, Howard University, received the Spingarn Medal for his work in chemistry at the conference session of the National Association for the Advancement of Colored People. The presentation was made by Harold C. Urey, Nobel Prize winner, University of Chicago.

Mary Lura Sherrill, head, Department of Chemistry, Mount Holyoke College, will be the recipient of the Francis P. Garvan Medal, honoring women in chemistry, at the 112th national meeting of the American Chemical Society, to be held in New York, September 15–19.

The Committee on Scientific Research of the American Medical Association has recently made grants to Otto Saphir, Michael Reese Hospital, Chicago; Roger M. Reinecke, Department of Physiology, University of Minnesota; I. Davidsohn, Mount Sinai Hospital, Chicago; L. R. Cerecedo, Department of Chemistry, Fordham University; James H. Leathem, Rutgers University; H. O. Burdick, Alfred University, Alfred, New York; Ernest A. Spiegel, Temple University School of Medicine; Ben Vidgoff, Department of Pharmacology, University of Oregon Medical School; Ruth Silberberg, Barnard Free Skin and Cancer Hospital, St. Louis; and Harold J. Harris, New York City.

The first prize-winning thesis in the 1946 Schering Award, sponsored by the Schering Corporation, Bloomfield and Union, New Jersey, has been published in its entirety in an attractive booklet which is available upon request. The booklet is entitled "The Role of Hormones in Sterility," subject of the award, which was won by Bent Boving, Jefferson Medical School. The topic for the current 1947 Schering Award contest, which closed July 31, is "The Clinical Use of Androgens in the Female."

S. B. Penick & Company, New York City, manufacturers of botanical products and fine chemicals, have recently established five research grants and extended a sixth. The University of Illinois is the recipient of a fellowship grant for the study of compounds from vegetable sources or of therapeutic agents, to be under the direction of Roger Adams, Department of Chemistry. Similar fellowships in the Departments of Chemistry at the University of Wisconsin, under the direction of S. M. McElvain, and at the University of California at Los Angeles, under the direction of William G. Young and T. A. Geissman, have also been established. Grants were also made to the Department of Pharmacology, Harvard University School of Medicine, where Otto Krayer will study the pharmacological action of certain botanical specimens of South American origin, and to E. M. MacKay and William G. Clark, Research Department, Scripps Metabolic Clinic, La Jolla, California, for the study of vitamin P-like substances and their effect upon animal organisms. A grant to the University of Michigan for the study of the therapeutic value of mixed estrogens from natural sources administered to the intact skin as an inunction, under the direction of E. C. Pliske, has been extended to January 1, 1948.

Meetings

Applications for admission to the Statistical Summer Session at Virginia Polytechnic Institute, August 5–September 5 (*Science*, May 16, p. 519), have been received from individuals in 26 states from New York to California, and Minnesota to Louisiana, and now number well over 100, according to Boyd Harshbarger, statistician at the Institute and chairman of the Session.

Prof. Harshbarger lists the tentative dates of attendance for outstanding statisticians, some of whom will be in Blacksburg for only a few days. Maurice G. Kendall, Royal Statistical Society, United Kingdom, has indicated he will be in Blacksburg the week of August 25, and Maurice Hansen, probably for the week of August 18. Daniel B. DeLury, until recently a statistician at V.P.I., and Gertrude Cox, University of North Carolina, are listed as seminar speakers for the statistical session.

Commenting on the widespread interest in the statistics school, Prof. Harshbarger states that the professions represented include people with such titles as wood technologists, meteorologists, sociologists, physicists, psychologists, analysts, experiment station directors, engineers, and biologists, to name only a few. In addition to USDA agencies and public health organizations, he has reservations from individuals associated with photograph companies, aircraft builders, life insurance agencies, weather bureaus, and publishers. Colleges and universities which are sending representatives are scattered throughout the United States.

The American College of Physicians will hold its annual meeting in the Civic Auditorium, San Francisco, April 19–23, 1948. William J. Kerr and Ernest H. Falconer, both of San Francisco, are co-chairmen for local arrangements and the program of clinics and panel discussions. Hugh J. Morgan, president of the College of Physicians, and professor of medicine, Vanderbilt University School of Medicine, is in charge of the program of morning lectures and afternoon general sessions. Secretaries of medical societies are especially asked to note these dates in order to avoid scheduling their own society meetings at this time.

The Executive Committee of the 13th International Congress of Zoology has announced that the Congress will be held in Paris, July 21–27, 1948. M. Caullery, chairman of the Permanent Committee of the Congress, will preside. The 10 sections with their presiding officers will be: General Zoology (M. Vandel); Evolution and Genetics (M. Teissier); Cytology and Protistology (M. Fauré-Frémiet); Comparative and Experimental Embryology (M. Wolff); Vertebrates: Comparative Anatomy (M. Prenant); Systematics and Ecology (M. Bourdelle); Invertebrates, excluding insects (M. Fage); Entomology (M. Jeannel); Applied Zoology and Parasitology (M. Vayssière); Zoogeography and Paleontology (M. Arambourg); and Nomenclature (M. Fischer-Piette). Correspondence relative to the Congress should be directed to the Secretary General, M. Fischer-Piette, 55 rue de Buffon, Paris, France.

In spite of efforts of the Executive Committee, it was not possible to arrange for the Congress to be held either just before or just after the two Congresses to be held in Stockholm (Genetics and Entomology), and the dates have therefore been set between the two.

A circular containing material on the Congress is being sent to academies, universities, museums, and societies. If any organization or institution does not receive a copy, the Secretary General should be informed.

The Pittsburgh Conference on X-Ray and Electron Diffraction will be held this year on November 7–8 at the Mellon Institute of Industrial Research, under the sponsorship of local members of ASXRED, the University of Pittsburgh, and the Institute. A program for the meetings is now being planned. The program chairman, Earl Gulbransen, has appointed William Kirkpatrick to organize a session on interstitial compounds; a session on electron diffraction studies at high temperatures will be organized by J. Hickman. Two other sessions will consist of contributed papers of not more than 30 minutes each. Information and suggestions concerning the Conference should be directed to Harold Klug, Mellon Institute of Industrial Research, 4400 Fifth Avenue, Pittsburgh, while titles and abstracts of papers to be presented should be sent to Earl A. Gulbransen, Westinghouse Research Laboratories, East Pittsburgh. Titles should be submitted on or before September 1; short abstracts, on or before October 1.

The Yearbook of Agriculture 1943–1947, entitled *Science in farming*, which has been prepared in the U. S. Department of Agriculture. is currently being distributed. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is $2.00. This new book, which contains 1,094 pages and includes 135 reports and 136 pages of illustrations, embraces research on the breeding and feeding of livestock, animal diseases, poultry, genetics, plant growth, vegetables, field crops, plant diseases, trees and farm forestry, fertilizers, conservation, insecticides, and a wide variety of other relevant topics.

The 75th anniversary of the founding of the Anderson School of Natural History on Penikese Island is to be commemorated this year at the Marine Biological Laboratory, Woods Hole, Massachusetts, both by a biological survey of Penikese Island and by an exhibition of Agassiziana in the Library of the Laboratory.

The survey of the westernmost of the Elizabeth Islands will be undertaken on Sunday, August 3, by interested workers from the Woods Hole Oceanographic Institution, the Woods Hole Laboratory of the U. S. Fish and Wildlife Service, the Marine Biological Laboratory, and others who have been invited. Participants will be divided into botanical, ecological, and zoological groups which will be under the direction of John S. Rankin, Jr., of the University of Connecticut, and Donald J. Zinn, of the Marine Biological Laboratory.

The exhibit, during the week of August 10, will consist primarily of letters, manuscripts, papers, and books of Louis Agassiz, former director of the Museum of Comparative Zoology, Harvard University. Various individuals and institutions are lending valuable items for the occasion. Alfred S. Romer, present director of the Museum at Harvard, and others have been invited to speak during the week of the exhibit.

Sir Isaac Newton's Correspondence

The Royal Society of London reached another climax in its long and distinguished history with the outstanding tercentenary celebration, during July 1946 in London and Cambridge, of the birth of its noblest member and president, Sir Isaac Newton. The complete record of the commemoration will be preserved as a valuable and definite contribution to the whole history and philosophy of science. This commemoration will be remembered not alone for the great assembly of distinguished scholars from the world over, but also for the opportunity for a revaluation of Newton's works in terms of today's accomplishments. The respect for Newton's memory shown by such a cosmopolitan group of 148 delegates from almost all of Europe, Asia, South Africa, USSR, South America, and the United States—and even Germany (the venerable 88-year-old Max Planck representing, presumably, no country)—is long to be remembered.

The Royal Society now has in view an even greater and longer-lasting commemoration, namely, the publication of the complete collection of Isaac Newton's correspondence and the replies thereto. The announcement of this undertaking was first made in *The Times* (London, April 25, 1947) by E. N. da C. Andrade, F.R.S., professor of physics in the University of London:

"Although Isaac Newton is acclaimed as the greatest leader of scientific thought that the world has known, there exists no satisfactory collected edition of his work, for that in five volumes which Horsley issued from 1779 to 1785 under the title *Opera Quae Exstant Omnia*, is woefully incomplete. The difficulties in the way of producing a definitive collected edition are many and considerable, one of them being the great mass of unpublished papers which would have to be sifted by scholars of expert experience before those of significance could be extracted and put in order. The task is not likely to be achieved in the immediate future.

"The Council of the Royal Society has decided, however, to make a first step in the direction of producing a worthy edition of Newton's works by publishing the letters which Newton wrote and the replies to them. Some of these letters have been already published in, for instance, the two volumes of correspondence of scientific men of the seventeenth century edited by S. J. Rigaud, but a larger number, including many in the possession of the Royal Society, exist only in manuscript.

"The Council of the Royal Society has entrusted the immediate organization of the matter to a Subcommittee of the Society. It is as chairman of this Subcommittee that I request, with all courtesy, owners of letters to and from Newton to be kind enough to notify the Assistant Secretary of the Royal Society, Burlington House, as to what they possess, in order that, with their permission and cooperation, arrangements may be made either for the temporary loan of the pieces in question or for the supply of photographs. Curators of libraries, museums, and collections are also asked to cooperate in this matter."

It is both appropriate and fortunate that the Council has placed in charge of this undertaking two of its well-known members and Newtonian scholars: H. W. Turnbull, F.R.S., Regis professor of mathematics, United College, University of St. Andrews, as general editor, and Prof. Andrade as chairman of the Subcommittee

It is self-evident that a comprehensive and critical edition of Newton's correspondence is the first desideratum before a complete, national, collected edition of all of Newton's writing can be attempted and, in fact, also before a new life story of Newton can be written. His letters must *all* be available. There are two partially collected volumes of letters, Edleston's *Correspondence of Sir I. Newton and Prof. Cotes*, including letters from other eminent men, from the originals in Trinity College (Cambridge, 1850), and Rigaud's *Correspondence of scientific men of the XVII century*, including letters of Barrow, Flamsteed, Wallis, etc. (Oxford, 1841). Many other sources contain letters, such as Brewster's *Life of Newton* (1855) and More's *Life of Newton* (1934). In addition, there are collected works of Huygens and Leibnitz. The largest collections of Newton's letters are in the libraries of the Royal Society, Cambridge University, Trinity College, Kings College, Christ's College, Oxford, and the British Museum. There are also such private collections as the Macclesfield. Of late, a number of Newton letters have come on the open market from the Viscount Lymington Library, recently dispersed by Sotheby, London. These were quickly disposed of. It is the letters that have been dispersed for which search must be made.

A more interesting and historically important publication could not be anticipated, for Newton's correspondence covered a period of nearly 60 years and was, in fact, enormous for a single individual of his period. The greatest array of late 17th-century and early 18th-century names in the history of science are among Newton's correspondents, e.g. Isaac Barrow, Richard Bently, Joh. Bernouilli, Robert Boyle, J. Collins, Roger Cotes, John Flamsteed, B. de Foutenelle, James Gregory, Edmund Halley, Robert Hooke, C. Huygens, John Keill, G. W. Leibnitz, John Locke, C. MacLauren, Henry Pemberton, Samuel Pepys, Abbé Varignon, John Wallis, and Christopher Wren. It is doubtful if there ever was a single individual in the history of science who had so large and distinguished a list of correspondents. It was natural that this should be so, because Newton laid the foundation in three important fields: modern mathematics, optics, and dynamics. It is not known that Newton was interested in music; however, in the Portsmouth Collection are several manuscripts bearing upon the theory of music as related to sound, but no correspondence seems to be known in connection with this. As Fellow of Trinity College, Member of Parliament, Director of the Mint, and President of the Royal Society with the longest term known, his correspondence concerned all sorts of phases of science and was with all sorts of individuals. These letters will undoubtedly reveal unknown history of both Newton the man and the scientific spirit of his time. Each of his biographers, from Brewster, his first, to More, his last, has selected and read only a fraction of these letters for his particular need.

As an example of the need of a collected edition of Newton's letters, a more valuable and significant group of letters could never be found in the history of mathematics and astronomy than the correspondence between Newton and Halley relating to the preparation of the *Principia* during the period between 1686 and 1687, and between Newton and Cotes during the preparation of the second edition in 1713. The letters exchanged by Newton and Pemberton relating to the editing of the third edition, and the correspondence between Newton and Flamsteed, Newton and Oldenburg, and Newton and Huygens, are also of the greatest importance and interest.

The increasingly keen interest in Newton and his influence through the ages has been demonstrated quite abundantly, particularly in the past 50 years, through the literature from philosophic and scientific journals. Further and larger commentaries have been published in book form, including a number of recent biographies in English, German, and Spanish. There have also appeared two reprinted editions of the *Principia* and *Optics*, both in the United States and Russia. The publication of Newton's correspondence will stimulate further research.

The next desideratum in the agenda of Newton's revaluation is a more comprehensive and complete bibliography brought up to date. Here again, commemoration of Newton's death (Bicentenary, 1927) and birth (Tercentenary, 1942, but commemorated in 1946), a great celebration by the Academy of Sciences of the USSR in 1942, and the commemoration of the 250th anniversary of the publication of the *Principia* have produced several hundred new titles in books and periodical literature. A record of all this literature would seem to be imperative. Each of the two bibliographies now in print (Gray's, 1907 and Zeitlinger's, 1927) is limited; the first contains 412 titles, and the latter is a critical annotated list of Newton's own publications. The undersigned hopes to complete within one year a new bibliography of Newton which now comprises more than 2,000 titles. It is intended to extend this bibliography to include all titles (as, for instance, Celestial Mechanics) having a direct bearing upon Newton's laws.

Clearly, before the greater project which the Royal Society has in view can be undertaken, it is necessary that all of Newton's letters be made available and in print. Likewise, a critical annotated bibliography of Newton's writings and commentaries should be encouraged for the identical purpose, since both projects would aid the editors of the national edition to secure further critical and historical data.

Newton's influence in America began early in the cultural progress of the colonies. Scholars and teachers at Harvard College, Yale College, and the College of William and Mary (Cotton Mather, John Winthrop, David Rittenhouse, James Logan, James Madison, and many others) helped greatly to establish our first definite scientific epoch in the colony. Newton's first correspondent in the colonies was Arthur Storer, of Patuxent River, Maryland. Storer sent Newton fairly respectable observations of the comet of 1680. Thomas Brattle, of Harvard College, sent similar notes to Flamsteed, the first Astronomer Royal at Greenwich. Both sets of observations were used by Newton and Halley to facilitate the determination of the first complete set of orbital elements of a comet and thereby established the law of gravitation as related to celestial bodies and made possible the beginning of the *Principia*.

The Royal Society desires to advise those collectors and scholars, as well as libraries, here in America who are in possession of letters written by Newton and replies to him that it would greatly appreciate their cooperation in the loan of the letters or a photographic copy of them. The undersigned, who is a member of the Subcommittee representing the Royal Society in this project, would therefore be grateful for notification of the whereabouts of these letters in order to facilitate their transmission to the editors of the proposed work. (FREDERICK E. BRASCH, *Honorary Consultant in the History of Science, Library of Congress, Washington, D. C.*)

Make Plans for—

American Veterinary Medical Association, August 18–21, Cincinnati, Ohio.

New England Association of Chemistry Teachers, 9th Summer Conference, August 18–23, Wellesley College, Wellesley, Massachusetts.

American Pharmaceutical Association, August 24, Milwaukee, Wisconsin.

American Society of Mammalogists, August 24–27, Higgins Lake, Michigan.

American Institute of Electrical Engineers, Pacific General Meeting, August 26–29, San Diego, California.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Preparation of Formaldehyde-inactivated Poliomyelitis Virus and Its Use as an Immunizing Agent in Cotton Rats[1]

Hubert S. Loring, C. E. Schwerdt, Nancy Lawrence, and
Jane Collier Anderson

Department of Chemistry and *School of Medicine,*
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The inactivation of relatively crude preparations of poliomyelitis virus by formaldehyde treatment and by ultraviolet irradiation has resulted in samples capable of producing a significant immunity against an intracerebral challenge of active virus. The extent to which such immunity has depended on the presence of humoral antibodies or of virus-resistant nervous tissue is not known, but the presence of neutralizing antibodies in the blood after immunization has been demonstrated (*1*). The vaccines used in such experiments have consisted of extracts of finely-ground brain and spinal cord of infected monkeys or mice and contained relatively small quantities of virus and large quantities of normal tissue components.

The use of such crude vaccines is objectionable for several reasons. It is likely that higher concentrations of formaldehyde would be required to produce complete inactivation because of the protective colloid action of the normal proteins on virus and because of competitive reactions between the two for formaldehyde. As formaldehyde concentration is increased, it is also likely that not only virus activity but antigenicity would be lost. A further objection to the use of crude preparations is the large mass of tissue proteins which must be injected in order to provide a sufficient quantity of inactive virus to stimulate an appreciable antibody response. If an inactive-virus antigen free from the normal tissue components were available, it is possible that a much greater response could be elicited and a higher degree of immunity achieved.

The development of a method of preparation of concentrated Lansing virus in moderate quantities (*2*) has made possible the study of the inactivation of virus relatively free from normal tissue constituents and the use of such a material for immunization against active virus. Lansing virus produced in cotton rats and purified by two cycles of differential ultracentrifugation was treated with formaldehyde in concentrations from 0.02 to 0.1 per cent by volume. The concentration of virus used varied from 3×10^{-4} to 4×10^{-4} grams of nitrogen/ml. The mixture of virus and formaldehyde in M/15 phosphate buffer at pH 7 was stored in the refrigerator and its infectivity in comparison with the original untreated virus determined after different time intervals. Infectivity of each preparation was measured by the intracerebral injection of six 10-fold dilutions in six groups of five young cotton rats each. A volume of 0.05 ml. was used for each animal, and the specific infectivity was calculated as the 50 per cent infective dose, or ID_{50} in grams of virus nitrogen/ml. (*2, 3*). The results of five experiments with three different formaldehyde concentrations are shown in Table 1.

The results show that at refrigerator temperatures the Lansing virus is completely inactivated by formaldehyde only when a concentration of 0.1 per cent is used and the virus and formaldehyde mixtures are allowed to stand for somewhat longer than 12 days. After four days of contact with 0.1 per cent formaldehyde, one treated virus sample was completely inactive, and after 12 days another showed only a trace of activity (less than 0.0002 of one per cent). In the latter experiment no activity could be detected when the mixture had stood for an additional 38 days. In contrast to concentrated influenza virus, the Lansing virus shows an appreciably greater resistance to inactivation by formaldehyde (*4*), a result in agreement with its recognized greater stability.

TABLE 1

Activities of Original Virus and of Virus Formaldehyde Mixtures After Standing in Refrigerator for Varying Lengths of Time

Expt. No.	Concentration of formaldehyde (%)	Specific activity as grams nitrogen/ml.* after:				
		4 days		12 days		50 days
		Original virus	Treated virus	Original virus	Treated virus	Treated virus
86	0.02	$10^{-9.7}$	$10^{-8.7}$	$10^{-9.0}$	$10^{-4.9}$	
88	0.05	$10^{-9.9}$	$10^{-7.1}$			
89–90	0.05			$10^{-9.7}$	$10^{-7.0}$	
87	0.10	$10^{-8.3}$	Completely inactive at $10^{-3.7}$			
91-2-4	0.10			$10^{-11.7}$	$10^{-4.0}$†	Completely inactive at $10^{-3.4}$

* Calculated by the method of Reed and Muench (*3*).

† At the highest concentration used, $10^{-3.7}$ grams nitrogen/ml., two out of three rats developed poliomyelitis. No animals showed positive signs at lower concentrations.

In the early experiments on the ability of the formaldehyde-inactivated virus to immunize cotton rats, the intraperitoneal route of injection was used. In one such experiment, in which 32 young cotton rats were immunized by two intraperitoneal injections containing a total of 3×10^{-6} grams of completely inactive virus nitrogen (Experiment 87, 0.1 per cent formaldehyde after 4 days), 18 per cent of the test animals survived a challenge of 100 ID_{50} doses given four days after the last injection. When 9 control animals were challenged with the same dose of virus, 1 was found dead after four days without previously recognized signs of the disease and 8 developed typical poliomyelitis.

More significant results were found when the rats were im-

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[1] Aided by a grant from the National Foundation for Infantile Paralysis, New York City.

munized by three injections given at weekly intervals by a combination of the intradermal, intramuscular, and subcutaneous routes. A total of 10^{-6} grams of formalized virus nitrogen (Experiment 91-2-4 after 12 days) was administered to each of 30 rats in three doses as follows: $10^{-6.6}$ grams of nitrogen intradermally, $10^{-6.3}$ grams of nitrogen intramuscularly a week later, and $10^{-6.6}$ grams of nitrogen subcutaneously at the end of another week. A similar group of animals was immunized by the same method with 10^{-6} grams of nitrogen of the same vaccine in a petroleum oil suspension.

The degree of immunity present in the two groups was estimated by finding the titer of active virus in each in comparison with that of normal control animals of the same age. Concentrations of virus were prepared in steps of 10 from 2×10^{-10} to 2×10^{-6} grams of nitrogen/ml. Each concentration was then injected intracerebrally in a volume of 0.05 ml. into each of five animals from the two immunized groups one week after the last vaccine injection. The control animals were tested similarly with concentrations of virus ranging from 2×10^{-12} to 2×10^{-7} grams of nitrogen/ml. The titer of virus used was calculated from the control animals and, expressed as the ID_{50} dose, was found to be $10^{-11.7}$ grams of nitrogen/ml. Similar titers calculated for the two immune groups were $10^{-6.2}$ for the first mentioned and $10^{-6.5}$ for the group injected with vaccine in oil emulsion.

It is evident from these titers that over 300,000 times as much virus was required to infect 50 per cent of the first group of vaccinated animals as was found necessary for the normal controls. Similarly, in the second group, 150,000 times as much virus was required.

The survivors from both groups were pooled and rechallenged by the same method 10½ weeks after the first challenge. The titer found with the immunized animals as compared with that of their normal controls showed that about 500 times as much virus was now required to infect 50 per cent of the immunized group.

It is possible that the high degree of immunity produced in the experiment cited above was due to the presence of the trace of active virus found in this preparation. Further immunization experiments with the vaccine which showed no virus activity were carried out to test this question. Twenty-four rats immunized with the same amount of completely inactive vaccine by the three routes previously used were each challenged intracerebrally one week after the last injection with about 1,000 ID_{50} doses of active virus. One of the group developed paralysis but recovered, while the remaining 23 showed no signs of the disease. In a similar number of normal control animals receiving the same dose of virus 83 per cent developed poliomyelitis. It is likely, therefore, that the extent of immunity produced by the vaccine after 12 days of exposure to formaldehyde was due to the inactive virus rather than to the traces of activity present.

The 24 survivors from the last-mentioned experiment were rechallenged with 10,000 ID_{50} doses of virus three weeks after the first challenge. A high degree of immunity was still present, as shown by the fact that 67 per cent of the animals survived without showing signs of poliomyelitis as compared to 92 per cent of a similar group of normal controls which developed the disease when injected with the same amount of virus.

The results presented show that coccentrated Lansing virus from cotton rats can be completely inactivated by formaldehyde and that such inactive virus can be used to produce a high degree of immunity toward the homologous virus. The data show that infectivity as such is not a prerequisite for a vaccine which, in amounts of 10^{-6} grams of concentrated virus nitrogen, produces a highly significant protection against the intracerebral injection of active virus. Whether protection is obtained by neutralization of virus at the site of injection by humoral antibodies or by some other mechanism is not known. The presence of neutralizing antibodies in high titers in the blood of the immunized rats has been demonstrated both by neutralization tests and by the complement fixation test. These results will be presented in an early publication.

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Filaricidal Activity of Substituted Phenyl Arsenoxides[1]

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In the treatment of both canine and human filariasis antimony-containing compounds have been used to the exclusion of almost all other types of therapy. Accordingly, early in our search for an improved form of therapy considerable attention was given to new or hitherto unexplored antimony compounds. The results were disappointing in that we failed to obtain evidence that antimony in therapeutically feasible doses would ever regularly kill the adult filaria, *Litomosoides carinii*, of cotton rats or *Dirofilaria immitis* of dogs. We therefore intensified our search for an entirely different type of therapeutic agent. Consideration was given to the possible advantages of nonmetallic compounds, but in so far as our investigations were carried no such compound was found which appeared to offer any advantages over the antimonials.[3] However, preliminary screening revealed that Mapharsen had an *in vitro* microfilaricidal activity far greater than anything hitherto reported. This led to a study not only of Mapharsen itself but of the whole group of available substituted phenyl arsenoxides.

The attempt to use arsenic in the treatment of filariasis is not new. Among the more recent advocates of its possible value in the therapy of filariasis are King (*4*) and Van der Sar and Hartz (*8*), who obtained evidence of clinical improvement without destruction of the microfilaria following the use of

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[1] This work was carried on initially under a contract recommended by the Committee on Medical Research between the Office of Scientific Research and Development and The Johns Hopkins University; it was continued under a contract between the Office of the Surgeon General, U.S.A., and the same university.

[2] Now in the Department of Pharmacology and Experimental Therapeutics, School of Medicine, The Johns Hopkins University.

[3] Welch, *et al.* (*9*) have since reported favorable results with cyanines in laboratory animals.

Mapharsen. It is of interest that in Hawking's study (*3*) of the *in vitro* killing of microfilaria of *Wuchereria bancrofti*, 6 of the 7 trivalent arsenicals killed the microfilaria at greater dilution than did any of the 28 other compounds used, including two antimonials (tartar emetic and fuadin). Apparently Goodman and Gilman's statement (*2*) that "micro-filaria can be killed by organic arsenicals" results from Hawking's report, although that worker and Chopra and Rao (*1*) were unable to obtain evidence of *in vivo* killing of microfilaria by these arsenicals.

We have conducted both *in vitro* and *in vivo* studies on the effect of various compounds on microfilaria and adult filaria as well as a study of the toxicity, absorption, and excretion of those offering promise of therapeutic value. However, discussion will be confined here to the filaricidal activity of the substituted phenyl arsenoxides with particular reference to p-[bis-(carboxymethylmercapto)-arsino]-benzamide (Tropical Disease Center #970).

The group of phenyl arsenoxides was shown to have an *in vitro* activity against the microfilaria of *D. immitis* 10–300 times that of the most active of the antimony compounds tested. Thus, within the group of phenyl arsenoxides there was approximately a 30-fold difference between the least active and the most active, whereas there was scarcely more than a 3-fold difference in the acute toxicities for mice. The amide substituted compounds, such as those with the p-CONR$_2$ or p-SONR$_2$ substitution, killed the microfilaria at the highest dilutions. Despite previous reports of the failure of Mapharsen to reduce the microfilaria blood levels in man, this seemed to warrant further study. Accordingly, it was administered to cotton rats infected with *L. carinii* in doses of 0.9 mg. As (3.0 mg. Mapharsen)/kg. b.i.d. intraperitoneally for 45 days and to a dog, infected with *D. immitis*, in doses of 0.6 mg. As (2.0 mg. Mapharsen)/kg. intravenously daily for 35 days. The results were completely negative.

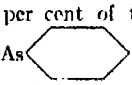
Six other phenyl arsenoxides, kindly supplied by Harry Eagle, of the U. S. Public Health Service, were administered intraperitoneally to cotton rats in doses of 0.9 mg. As/kg. b.i.d. for 25 and 45 days. All showed some activity, and all four of the amide substituted compounds reduced the microfilaria blood levels 70–90 per cent during the course of treatment; three of them killed 90–100 per cent of the adult worms. Only p-arsenosobenzamide (OAsCONH$_2$), among these compounds, killed all the adult worms in half the above daily dose (0.45 mg. As/kg. b.i.d.) for the same length of time and reduced the microfilaria blood level 50–80 per cent. In lower doses and for shorter periods of time there was some lethal action upon the adult worms but little or no reduction in the microfilaria level. In dogs with daily intravenous doses of 0.45 mg. As/kg. it failed to produce any reduction in the microfilaria count, but in each of the two animals killed at the end of treatment 6 dead, but no living, worms were found in the pulmonary arteries. The microfilaria blood level of the remaining dog was followed for one year and dropped in that time to about one-fifth of its pretreatment level, while the microfilaria count actually rose in the untreated animal. When the animal was necropsied, one living adult was found in the heart. Since this compound is so insoluble (about 1:800 in water), work with it was discontinued and consideration given to the synthesis of a more soluble analogue.

TABLE 1

TREATMENT OF *Dirofilaria immitis* WITH DAILY INJECTIONS OF #970

Dog	Daily dose (mg. As/kg.)	No. of injections	Total dose (mg. As/kg.)	Fate of dog	Adult worms	
					Alive in heart	Dead in pulmonary artery
11	1.8	5	9	D, 5 days	33 (Sluggish)	5
25	1.8	3	5.4	" "	0	3
5	0.9	30	27	Healthy, K	0	11 ♀ 11 fr.†
27	0.9	30	27	" "	0	2 fr.
28	0.9	15	13.5	" "	0	7♂ 2♂ 2 fr.
9	0.9	15 (alternate days)	13.5	" "	1 ♀ (Sluggish)	0
29	0.45	15	6.8	" "	0	3 ♀ 2 fr.
32	0.23	15	3.4	" "	0	4 ♀ 6♂ 2 fr.
31	0.23	11	2.5	D,* 12 days	0	19 ♀ 12♂
34	0.115	15	1.7	Healthy, K	2 ♀ 1♂ (active)	0

* This dog was critically ill before experiment started.
† fr. = fragmented.

A number of compounds were studied in which organic radicals were substituted for oxygen in the p-arsenosobenzamide. The dithioglycollate substituted compound which was made in our laboratory (*5*)[4] seemed to offer promise of both solubility (2 per cent solutions are practical) and a favorable therapeutic index. This compound, p-[bis-(carboxymethylmercapto)-arsino]-benzamide, killed all the adult worms in cotton rats receiving 0.9 mg. As (4.5 mg. drug)/kg. b.i.d. intraperitoneally for 6 weeks but failed to effect any reduction in the microfilaria level; various shorter courses of treatments killed some of the adult worms. The administration of the drug intravenously to dogs infected with *D. immitis* likewise failed to reduce the microfilaria level during the course of treatment. On the other hand, the drug seems to be consistently effective against the adult worms in daily doses of 0.23 mg. As (1.15 mg. drug)/kg. or more for two weeks or longer. It appears also that effectiveness of the drug may not be measured in terms of the total dose alone, since a total of 9.0 mg. As/kg. given in 5 daily doses of 1.8 mg. As/kg. (dog 11) and 13.5 mg. As/kg. given as 0.9 mg. As/kg. every other day (dog 9) did not kill all the adult worms, whereas smaller total doses, 3.4 mg. and 6.8 mg. As/kg. (dogs 32 and 29), given in doses of 0.23 and

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[4] We are indebted to C. K. Banks, of Parke, Davis & Company, Detroit, who later supplied the main stock and its precursor (#622) from which we made much of our supply, and to Fitzgerald Dunning and J. H. Brewer, of Hynson, Westcott, and Dunning, Baltimore, who ampouled the compound in 2 per cent solution for use.

0.45 mg. As/kg. daily for 15 days were effective (Table 1). The comparative series is admittedly small, but it is supported by similar experience with the same drug in cotton rats infected with *L. carinii*. More work is needed to determine whether or not the effective dose is lower than 0.23 mg. As (1.15 mg. drug)/kg. daily for 15 days or even to state with certainty that this dose would always be effective. However, 0.23 mg. As/kg. doses of this drug for 15 days appear to be feasible for man. Thus, for the first time, so far as we know, a chemical compound has been shown to kill all the adults of *D. immitis* in doses which appear to be feasible for man.

As pointed out in our brief summaries (*6, 7*), this compound has approximately the same toxicity for laboratory animals as Mapharsen; it is tolerated by monkeys in doses of 0.9 mg. As/kg. for 20 days. It contains 20 per cent arsenic and is stable either as a powder or as a 2 per cent solution (*5*). Studies are accordingly now in progress to determine its possible value when used against both canine and human filariasis under conditions of routine practice with these infections.

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The Development of Visual Perception in Man and Chimpanzee

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The study of innate visual organization in man is not open to direct observation during early infancy, since a young baby is too helpless to respond differentially to visual excitation. A first attack on this problem has been made by investigating the visual responsiveness of persons born blind and later made able to see by cataract removal. To evaluate the apparent contradictions between these clinical reports and experimental findings with lower mammals and birds, chimpanzees were reared in darkness until sufficiently mature for the testing of visual responsiveness. The results, which corroborate and extend data reported for man by Senden (*3*), may require changes in current theories of learning and perception.

Two chimpanzees were reared in darkness to the age of 16 months.[1] The animals were then brought periodically into the light for a regularly repeated series of observations. By the time of the first observations the animals had developed postural and locomotor skills roughly comparable to normally reared chimpanzees of the same age or approximating in a general way those of a two-year-old human child. At this time the total light experience, received in half a dozen brief (45-second) episodes daily, as required by the routine care of the animals, was approximately 40 hours. At 21 months of age the female was brought permanently into normal indoor illumination. At the present writing the animals are 26 months of age. A full account of their behavior will appear in future publications.

The first tests of visual reactions with both subjects demonstrated the presence of good pupillary responses to changes in light intensity, pronounced startle reactions to sudden increases of illumination, and a turning of the eyes and head toward sources of light. In the darkroom there was pursuit of a moving light with both eye and head movements. The eyes, however, did not fixate steadily on a light. During all tests episodes of a resilient "spontaneous" nystagmus occurred, the quick phase usually toward, and the slow phase away from, the light source. With the subject sitting stationary at the center of a rotating drum marked in alternating black and white stripes, tests for optokinetic responses were made. Characteristic pursuit eye movements with quick jerks in the opposite direction were obtained.

Aside from the reflexes just described, and the pursuit of a moving light, the two animals were, in effect, blind. The acquisition of visually mediated responses proceeded very gradually, with no evidence of any sudden increased responsiveness such as might be expected if, for example, the failure to respond was at first due to a general lack of attention to visual stimulation. No fixation of any object, still or moving, could be elicited in any of the early tests. For a long time there was no eye blink when an object was brought rapidly toward the eyes. An object brought slowly toward the face produced no response until contact was made, when the animal reacted with a quick jerk in the typical startle pattern. With the female this was observed for the last time on the 30th day after she was moved into the daylight room. Her first blink to a threatened blow in the face occurred on the 5th day, but occurred consistently only after 48 days, at which time she had been in the light for a total of 570 hours, was 22½ months old, and had for a month received some pushing around daily in short play periods with a younger but visually sophisticated chimpanzee.

Many repetitions of experience with objects presented visually were necessary before any recognition of such objects appeared in either subject. The feeding bottle, for example, was thoroughly familiar tactually and kinesthetically. If the bottle or nipple touched the hand, arm, or face, either animal promptly seized the nipple in its mouth. First signs of *visual* recognition occurred in the female when she protruded her lips toward the bottle on the 33rd meal, or the 11th day, following her shift into the daylight room. The first reaching for the bottle with the hand (done before 12 months of age by normally reared animals) appeared on the 48th meal, or 16th day in the light. With the male, whose visual experience was limited to mealtime, many more feedings were required before these responses appeared. The first reaching responses of both animals were grossly inaccurate.

A training procedure employing electric shock showed that the learning of avoidance responses was also an extremely slow and gradual process.

These results can best be interpreted in conjunction with the data of Senden. Lacunae in each set of findings, clinical and experimental, are in many respects filled by the other.

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[1] The early rearing in the darkroom was arranged by H. G. Birch, whose part in this experiment is gratefully acknowledged.

In the first place, there is no question that the chimpanzee subjects were well motivated. Sufficient hunger to produce whimpering, and shock severe enough to bring vocal protests, did not alter the fact of failure to "see." The similar slowness of learning of the human patients therefore cannot be accounted for merely by a defect of motivation. The emotional disturbances would seem to have been the result of slow learning, just as Senden concluded, rather than its cause; that is to say, the patient lost some of his enthusiasm when he found how difficult it was to make effective use of the new and at first interesting sensations.

Secondly, the verbal assistance given the human patients make it clear that the difficulty is not simply a failure to attend to visual sensations. With attention successfully directed to a newly-introduced stimulation, as attested to by the patient's partial success in describing it, learning to identify remained a tediously slow process, with the notable exception of color naming. Since color names were learned easily, it cannot be said that "visual attention" was absent.

The prompt visual learning so characteristic of the normal adult primate is thus not an innate capacity, independent of visual experience, but requires a long apprenticeship in the use of the eyes. At lower phylogenetic levels the period of apprenticeship is much shorter. The chick makes effective use of vision immediately upon hatching and shows further improvement of efficiency with the practice afforded by a dozen pecks (*1*). Rats reared in darkness, when first exposed to light, show no clear utilization of vision but learn to jump in response to visual cues within 15 minutes and after an hour or two may be indistinguishable from the normally reared animal (*2*). The chimpanzees of the present study received 50 hours of exposure, before the first visually mediated learning was evident; and man, to judge by some of Senden's cases, may require an even longer exposure.

The comparative data conform to the generally recognized principle that organisms whose potential adaptations to the environment are most complex, *i.e.* those that show the greatest intelligence at maturity, also require the longest period of development. This has generally been regarded as a period of maturation. The clinical and experimental data discussed here, however, show that this long period is also essential for the organization of perceptual processes through learning.

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IN THE LABORATORY

Intestinal Perfusion in the Treatment of Uremia

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Interest in the removal of nonprotein nitrogenous constituents of the blood by "artificial" means in cases of renal failure has been stimulated greatly by the recent work of Kolff (*1*), Fine and his associates (*3*), Murray (*2*), and others. It has been suggested (*1*) that perfusion of a loop of bowel, isolated surgically, might prove superior in some respects to other methods presently used. It occurred to one of us (J. W. R.) that a specially designed intestinal tube with three lumina might make it possible to perfuse the intestine *in situ*, thus rendering surgical intervention unnecessary. Furthermore, aseptic technique would not be required.

By using a thin, triple-bore rubber tube, with a small balloon on the tip, it has been possible experimentally to perfuse any desired length of intestine without resorting to surgery of the bowel. However, in the dog it is necessary to manipulate the tube into position through an abdominal incision. This would be unnecessary in the human. Warmed perfusion fluid of physiological type has been introduced above the inflated balloon and withdrawn through another lumen of the same tube several feet higher up.

In experiments to date the blood nonprotein nitrogen of nephrectomized dogs has been reduced consistently and materially. For example, a lowering of the azotemia from 198 to 126, 198 to 112, and 231 to 145 mg./100 ml. of blood was observed in successive trials using 12–18 l. of perfusion fluid over a period of about 6 hours. The rinsing fluid after perfusion contained 4.3–5.4 grams of nonprotein nitrogen.

A more detailed experimental study of the method is now in progress and investigation of its clinical application is being undertaken.

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[1] Our thanks are due to C. H. Best, of the Department of Medical Research, and to John Mann, of the Department of Obstetrics and Gynaecology, for much appreciated help and stimulation.

Simple Method for Cross-indexing a Reference File

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In attempting to keep a reference file of current research one soons finds oneself in the perplexing situation of having several hundred cards on hand without an adequate cross-indexing system in operation. If, during the early stages of collecting reference material, one utilizes a multiple-card system, *i.e.* a separate card for each subject under which one particular reference can be filed, the number of cards needed soon makes space a limiting factor.

The ideal system, of course, is that in which only one card per reference is employed and which permits that reference to be selected from the file under any of several different subject headings. This ideal has been achieved in the punch-card system. However, to the average scientific worker this system presents two serious disadvantages: (1) Since special cards are used, the initial cost is fairly high; (2) having obtained these cards, transfer of the references from the original cards to the new ones necessitates an enormous amount of secretarial work.

The present communication describes a method for cross-indexing a file which is already in existence. The chief aims have been to obviate extra secretarial work and to achieve some advantages of the punch-card system.

In essence, the operation for cross-indexing involves notching the reference card along its top or side edges at positions corresponding to each of several different subject headings indicated on a master card.

Compilation of the master card is the most important task, since its design determines the ultimate efficiency of the system. Several features of the design deserve consideration: (1) One must decide at the outset which subject headings are likely to be most useful; the indexing system will do anything required of it, provided the subject headings are properly chosen. (2) The various headings are then divided into two classes, the *general* and the *specific*; *i.e.* for the general heading *Metabolism* there may be the specific headings *carbohydrate, fat, nitrogen, phosphate*, etc. (3) The importance of arranging these headings along the edges of the master card becomes apparent when one realizes that only the top edges of the cards are immediately visible in the file drawer. Since a reference is more commonly sought under a specific rather than a general subject heading, the former are made more readily available by arranging them along the top edge of the master card.

The master card itself is made from an ordinary blank card of the size used in the file, holes 2 mm. in diameter and about 2 mm. apart being punched along each of its top and two side edges. Subject headings are then listed opposite the holes.

In the author's file, general headings such as *Biochemistry, Metabolism, Enzymology, Pharmacodynamics*, are listed along the left-hand margin and specific headings along the top edge. Since it is also useful to know the tissue or organism used in a physiological study, the right-hand margin contains such specific headings as *amphibia, yeast, liver, brain*, etc.

To index a reference, the master card is superimposed over the card containing the reference, pencil marks being made on the latter through the holes in the master card opposite the appropriate headings. The reference card is then notched by punching semicircles opposite the marks. If the master card has been properly designed, each card should have at least one notch on each of its two side edges. (There may not be a notch along the top edge if the subject is of a general nature.)

The notched cards are finally filed alphabetically, by authors, under sections corresponding to the general headings listed on the left-hand margin of the master card.

The availability of data under this system is readily apparent. General information is obtainable at once, since the file is arranged in general sections. As each card in the general section has been punched in the same position along its left-hand margin, the section as a whole now exhibits a groove, along its side. Any card out of place shows up as a break in the groove.

To find a specific reference in a general section, the cards are first brought into alignment by moving them against one side of the drawer. The master card is then held in position in front of the section, or moved horizontally over the section if it is a long one, and the desired cards selected. Subjects listed along the right-hand margin are discovered by removing the section in whole or in part and bringing the cards into alignment both side and bottom; the master card is then used in the same manner to find a specific reference.

By this method it is possible to select one or two specific references out of several hundred cards in a matter of seconds. Furthermore, within a given section (e.g. *Metabolism*) all the references relating to one specific heading (e.g. *phosphate*) may be selected, or within the same section all the references pertaining to a specific tissue may be found with equal ease.

A Culture Medium for the Primary Isolation of Fungi

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Although Sabouraud's dextrose agar is widely employed for the cultivation of fungi, it has many shortcomings, particularly when used for the primary isolation of pathogenic fungi from material containing a mixed flora including bacteria, yeasts, actinomycetes, or saprophytic fungi. Gram-positive and gram-negative bacteria grow luxuriantly and rapidly on the medium, making it difficult to isolate pathogenic fungi from specimens such as feces, sputum, or exudates. Many clinical specimens must be treated with 70 per cent alcohol or other agents to destroy surface bacteria if dermatophytes are to be successfully isolated on Sabouraud agar. The acid reaction of the medium may prevent or retard the development of those pathogenic fungi for which the optimum pH is in the neutral or alkaline range. Furthermore, the utility of Sabouraud agar is seriously hindered by the rapid spreading growth of saprophytic fungi, which are invariably present in pathological specimens and in laboratory air. Since most pathogenic fungi grow more slowly than saprophytic species, they are isolated with difficulty in many cases or not at all in others. A new medium for the primary isolation of fungi was therefore thought to be very much needed. Studies were commenced along three separate lines of endeavor with that specific aim in mind.

The problem of restricting the spreading of fungi on agar media was first examined. After many different formulas had been tested, the following was found to support growth of 34 strains of pathogenic and saprophytic fungi in our collection as small, but well myceliated, discrete, *nonspreading* colonies at a rate comparable to that of Sabouraud agar: 1 per cent dextrose, 1 per cent granular peptone, 1.5 per cent dehydrated oxgall, and 2 per cent agar in water (no pH adjustment required).[1]

It was at first erroneously believed that oxgall in the concentration used above would inhibit gram-positive bacteria, particularly staphylococci. When this was proven not to be the case, other antibacterial agents known to be active against gram-positive bacteria were studied with a view to their incorporation into the medium. After a number of trials with different compounds, crystal violet[2] in final dilution of 1/100,000 was found to inhibit staphylococci and other gram-positive bacteria but not to hinder the growth of 34 known species of saprophytic and pathogenic molds, yeasts, and actinomycetes, as well as numerous strains of fungi isolated from laboratory air.

TABLE 1

FUNGI CAPABLE OF GROWING ON OXGALL-CRYSTAL VIOLET AGAR CONTAINING 30 UNITS OF STREPTOMYCIN/CC.

Pathogenic species	
*Blastomyces dermatitidis**	*Microsporum audouini*
" *brasiliensis*	" *canis*
Coccidioides immitis	" *gypseum*
Histoplasma capsulatum	*Trichophyton Schoenleinii*
Sporotrichum schenkii	" *violaceum*
Hormodendrum Pedrosoi	" *rubrum*
" *compactum*	" *mentagrophytes*
Phialophora verrucosa	" *sulfureum*
Cryptococcus neoformans	*Epidermophyton floccosum*
Candida albicans	*Monosporium apiospermum*
Torula (Elton)†	*Geotrichum* sp.
Nonpathogenic species	
Rhizopus nigricans (+)	*Candida candida*
" " (−)	*Fusarium*
Aspergillus herbariorum	*Alternaria*
Penicillium expansum	*Cladosporium*
" *notatum*	*Mucor mucedo*
Neurospora sitophila	*Scopulariopsis brevicaulis*

* Two strains.

† Isolated from a fatal case of meningitis.

Many chemical agents known to exert selective bacteriostatic activity versus gram-negative bacteria were investigated for addition to the oxgall-crystal violet agar; these included brilliant green, sodium azide and potassium tellurite. In no instance was it found possible to inhibit simultaneously all members of the Enterobacteriaceae family and the *Pseudomonas* genus without retarding or inhibiting some species of pathogenic fungi. Because of the wide range of activity of streptomycin against gram-negative bacteria and an observed high tolerance of one pathogenic fungus, *Blastomyces dermatitidis*, to streptomycin (*1*), this antibiotic was selected for trial. The hope that other species of fungi would show similar tolerance to streptomycin was fulfilled.

Oxgall-crystal violet agar was sterilized at 10-12 pounds pressure for 15 minutes[3] (115-117.7° C.) and then cooled to approximately 46°C. Sufficient streptomycin sulfate[4] in 5 cc. of sterile saline was then added and well mixed, immediately prior to pouring, to provide a final concentration of 30 units of the antibiotic/cc. of agar. All fungi in our collection were unaffected by the concentration of streptomycin used and grew unrestrictedly, with the exception of *Nocardia asteroides* (Table 1). Numerous laboratory aerial fungi, developing at approximately the same rate of growth in the streptomycin-containing oxgall-crystal violet agar as in Sabouraud agar, grew as small, well-isolated, *nonspreading* colonies (Fig. 1).

The degree of inactivation of streptomycin by brief exposure to 46°C. was not measured, but this was assumed to be negligible, since solutions of streptomycin can be heated to 100°C. for 10 minutes with loss of less than 50 per cent (*2*). In order to ascertain the stability of the antibiotic in the medium, streptomycin-containing oxgall-crystal violet agar was incubated at room temperature and 37°C. for varying periods and tested daily with pure cultures of *Escherichia coli* and fecal suspensions. Not only freshly prepared medium but also plates of medium incubated beforehand at both temperatures for a period of several weeks showed continued and undiminished, selective, inhibitory activity toward *E. coli* as well as most of the gram-negative bacteria present in normal and pathological feces. This attested to considerable stability of streptomycin in the poured medium.

A medium containing dextrose, peptone, oxgall, agar, and 30 units of streptomycin/cc. (excluding crystal violet) was streaked heavily with 10 different specimens of sputum. Since it was observed that a considerable number of gram-positive bacteria were able to form colonies on the medium, the presence of crystal violet as well as streptomycin was considered necessary in the formula.

The completed medium, containing, in distilled water, 1 per cent dextrose, 1 per cent peptone, 1.5 per cent oxgall, 2 per cent agar, 1/100,000 crystal violet, and 30 units of streptomycin/cc. of agar was tested in parallel with Sabouraud agar by heavy inoculation with specimens of feces and sputum obtained from the Clinical Diagnostic Laboratory, Charity Hospital, New Orleans. Approximately three times as many colonies of fungi and twice as many different fungal species could be recovered in pure culture from the new medium as from Sabouraud agar. Many specimens producing only a heavy bacterial overgrowth on Sabouraud agar developed 30–100 well-isolated mold and yeast colonies on the new medium (Fig. 2).

When used together in oxgall agar, crystal violet and streptomycin inhibited the growth of both gram-positive and gram-negative bacteria from heavy inocula of feces, sputum, and other grossly contaminated specimens. Molds and yeasts were permitted to grow as nonspreading, well-separated colonies which were easy to isolate in pure culture.

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[1] All elements of this formula are Bacto grade, Difco Laboratories, Detroit, Michigan.

[2] Crystal violet (indicator): dye content, 91 per cent; National Aniline Division, 40 Rector Street, New York City. *Stock solution:* 1.25 grams dissolved in 25 cc. of 95 per cent ethyl alcohol and kept in a tightly stoppered bottle. *For use:* 0.2 cc. added/liter of medium.

[3] Heating in excess of this pressure and temperature may cause the formation of an insoluble precipitate on the surface of the agar due to heat instability of the oxgall.

[4] Two commercial brands found satisfactory.

Present studies indicate that the new medium holds considerable promise as a diagnostic tool for the primary isolation of fungi from specimens possessing a mixed bacterial and fungal flora. It might also be employed (1) for an easier estimation of the *normal* fungal flora of feces, sputum, and other human discharges; (2) for a more accurate evaluation of human disorders of the upper and lower respiratory and gastrointestinal tracts caused by fungi; (3) as a simpler method of single-cell isolation of fungi; (4) for an accurate quantitative estimation of viable saprophytic fungi in foodstuffs by plating techniques; (5) for an easier estimation of the fungal flora and content of the air; and (6) as a more rapid and proficient method for the examination of feces and sputum in incipient infections of the civil population with fungal agents of disease. These possible applications will, of course, require confirmation by experimentation.

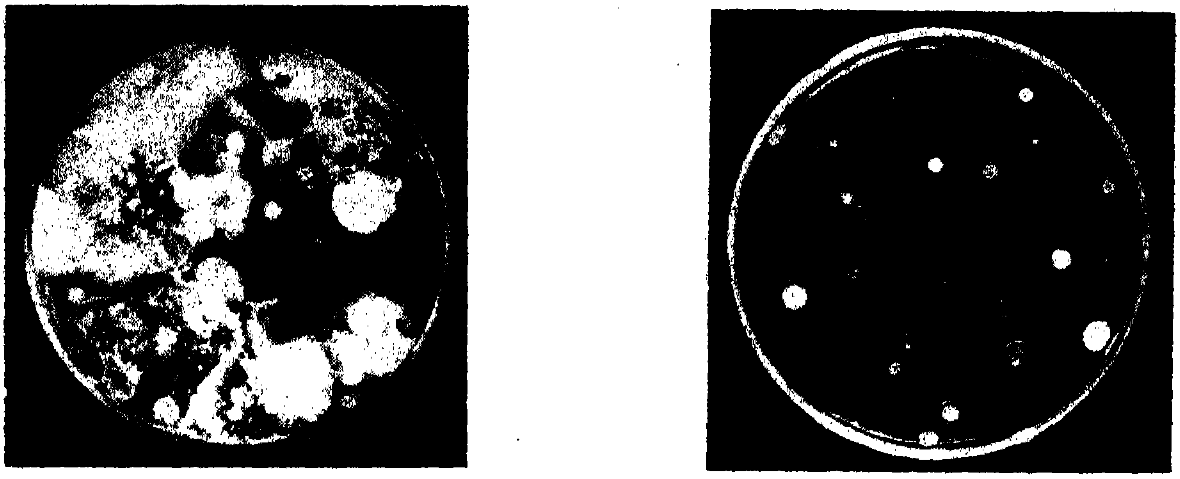

FIG. 1. Comparative appearance of media exposed to air for 4 hours, incubated 4 days at 30° C. *Left:* Sabouraud agar—marked spreading activity of aerial saprophytic fungi. *Right:* New medium—spreading activity reduced; note discrete, small colonies of fungi.

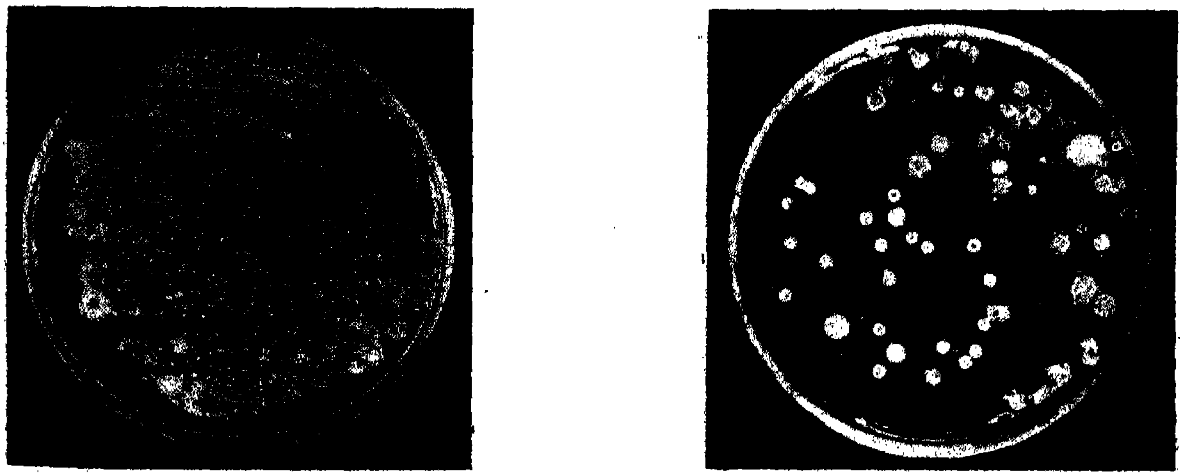

FIG. 2. Comparative appearance of media inoculated with heavy fecal suspension, incubated 4 days at 30° C. *Left:* Sabouraud agar—abundant bacterial growth which hindered fungal development. *Right:* New medium—minimal bacterial growth; note numerous, discrete, small colonies of fungi.

Addendum: It is our practice to distribute the medium in 500-cc. quantities in 1-l. flasks, sterilize, and store in the refrigerator until needed, at which time the agar is remelted and cooled to approximately 46°C. Streptomycin in sterile saline is then added and mixed thoroughly, and the agar is poured, 27–30 cc./plate. Plates of agar are left at room temperature 6–8 hours and then stored in the refrigerator. The poured agar appears transparent and light blue. In inoculating the medium, a generous quantity of sputum or fecal suspension in saline is vigorously spread over the surface of the agar using a sterile swab. Streaking by means of a wire loop is not required. Skin and nail scrapings and infected hairs are planted directly on the surface of the agar without preliminary treatment. Plates are incubated at room temperature, preferably at 30°C., but not at 37°C.

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Book Reviews

The Trematoda of British fishes. Ben Dawes. London: Ray Society, 1947. Pp. 364. (Illustrated.) 45/–.

The author's aim was to describe the trematodes of British fishes more fully than was possible in his book *The Trematoda* (*Science*, March 7, p. 268), but not to presume to treat the subject exhaustively. The author is to be credited with a laborious task well done.

Ninety species of monogenetic and 101 species of digenetic trematodes are listed by taxonomic groups. Some of the species are not known to occur in fish from British waters but are included because they occur in those from adjacent waters. In most cases the information for each species includes synonymy, a list of hosts, the location in the host, notes on geographical distribution, and a brief description of the species. Keys to 16 families in the Monogenea and to 17 families in the Digenea are provided. There is a bibliography of over 650 titles which reflects a thorough coverage of the pertinent literature, an alphabetical list of hosts, a list of hosts with their trematode parasites, and a general and systematic index.

This book may be considered as essentially a compilation of information from other sources, supplemented from first-hand experience with many of the species mentioned. Although the book is not a critical reference work on the subject, it will be of considerable value as a handbook and as a guide to the extensive literature on the subject.

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√ ***The rare-earth elements and their compounds.*** Don M. Yost, Horace Russell, Jr., and Clifford S. Garner. New York: John Wiley; London: Chapman & Hall, 1947. Pp. viii + 92. $2.50.

By monotonously laborious procedures of fractionation, the chemist achieved the separation and discovery of the rare-earth elements. Related chemically so closely, these puzzling elements did not fit into the then-existing periodic system. Their nature as well as the reason for their existence was hazy and confusing, and interest in them gradually waned almost to the vanishing point.

With the discovery and investigation of electrons, X-rays, and spectral lines, and the introduction of the quantum theory of atomic structure, combined with thermodynamics and statistical mechanics, the interesting magnetic and spectroscopic properties of the rare earths were explained, and the similar chemical behavior of these elements was clarified. A second shot of new life was recently injected into the rare earths through finding some of them as fission products of thorium and uranium, while nuclear research brought forward the concept of a second rare-earth-like series, beginning with Element 89 (actinium) and termed the actinide series.

The subject matter of the present monograph is divided into six chapters which discuss the electronic structures and oxidation states of the rare-earth elements, the paramagnetic properties and absorption spectra of rare-earth compounds, evidence for the existence of Element 61, separation of the rare earths, and their chemical and physical properties. Nuclear properties of the rare-earth elements, general physical constants, and the periodic system of the elements are given in three appendices.

The material of the book, carefully and critically chosen, constitutes reliable, modern information.

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The nature and prevention of the cereal rusts as exemplified in the leaf rust of wheat. (*Annales Cryptogamici et Phytopathologici,* Vol. IV. Frans Verdoorn, Ed.) K. Starr Chester. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1946. Pp. xvi + 269. (Illustrated.) $5.00.

This book represents the first attempt to bring together and summarize in English the literature on the rusts of cereal crops in general and the leaf rust of wheat in particular. The author not only presents complete published information on various phases under discussion, but also makes a commendable effort to analyze, interpret, and coordinate masses of information, some of which is in mimeographed form or in reports and similar material seldom cited. Those interested in rust research will be particularly grateful for the excellent summary of the Russian rust literature which, due to the language difficulties and appearance in obscure journals, often is not accessible and therefore is not well known in the Western Hemisphere.

The book is primarily a treatise on the leaf rust of wheat, although the other cereal rusts sometimes are discussed as illustrations of similar phenomena in leaf rust. In 15 chapters the history, origin, distribution, host range, effect on host plant and yields, symptomatology, etiology, physiologic specialization, survival and development, dissemination, epiphytology, and control of leaf rust are discussed at length. Investigators will find the chapters on physiologic specialization and control by rust resistance particularly interesting. The author's suggestion that the number of differential host varieties be reduced, thereby reducing the number of physiologic races by grouping similar races, presents a concept often discussed by uredinologists but seldom mentioned in literature. This suggestion will be favored by some investigators and condemned by others.

A list of 423 articles on rust appears at the end, and special praise is due for an excellent job of summarizing and bringing rust literature up to date in a single publication readily accessible to students and investigators.

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Operational Analysis in Relation to Administration of Government-sponsored Research

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ACCORDING TO THE BUSH REPORT (*3*), government expenditure for scientific research increased from approximately $50,000,000 in 1938 to $720,000,000 in 1944. An appreciable proportion of this increase was achieved by contracts with academic institutions through such agencies as the OSRD and the Engineer Corps, U. S. Army (Manhattan Engineering District). Since the war, government-sponsored research in academic institutions has been continued at an unprecedented rate, as compared with prewar practice, through the Army, the Navy, and the Atomic Energy Commission, and there is a possibility of further support through a National Science Foundation.

This trend has had its impact both on academic institutions and on government agencies. The former have had to learn that scientific research supported by government funds often involves considerably greater formality and detail in accounting, property control, and other administrative procedures than is characteristic of research supported, for example, by foundations. The latter have had to learn that restraint must be used in applying standard government practices to administration of research contracts, if the individual research scientist is to be permitted sufficient freedom to do effective creative work.

Although much progress has been made in evolving satisfactory relationships between government agencies and academic institutions for the sponsorship of research, the attempt to make adjustments that will enable such organizations to work together smoothly has resulted in certain difficulties. These appear to be due, in large part, to lack of understanding of the real problems involved.

We shall consider here some of these difficulties in the light of a method which may be used to discover and clarify the nature of the problems involved. The method may be called "operational analysis"—the examination of the relationships of abstract concepts, principles, or policies to operations, manipulations, or acts. Through this process, "operational definitions" are derived, and the abstract concepts, principles, or policies acquire "operational meaning." The latter is frequently different from the connotation which has been assumed by those concerned with administration of the policy or procedure. When this is made clear, difficulties can usually be resolved with comparative ease.

My own inclination to use this method for solving administrative problems related to wartime research contracts was the result of training in physics. Physicists are familiar with the operational definition of simultaneity as the basis of Einstein's special theory of relativity, and with the general method of developing operational definitions of concepts in physics, as discussed so ably by Bridgman (*2*), among others. The method is not confined to physics, however. The relating of abstract verbal or written language symbols to concrete acts or things has been developed by Korzybski and others (*5*) as "semantic analysis," and the investigation of the operational meaning of administrative and executive processes has been discussed by Barnard (*1*).

To illustrate the application of operational analysis, it will be instructive to consider some examples involving determination of the operational meaning of such expressions as "protecting the Government's interest" and "paper work." Government representatives frequently state that certain policies and procedures are necessary as a means of "protecting the Government's interest." Representatives of academic institutions may argue that the same policies and procedures merely increase "paper work" or "red tape."[1]

Such phrases have affective or emotional connotations. A loyal government representative might resent any implication that he is not trying to "protect the Government's interest." A self-respecting contractor's representative might, likewise, resent any implication that he is not trying to prevent increase of nonessential "paper work." Discussions involving abstract phrases having affective connotations are apt to end in illogical disagreements, unreasoned conclusions, and purposeless actions, unless both parties make a real effort to relate these phrases to the actual operations involved in the particular situation under discussion (*4*, *5*).

As a specific case, let us consider a contract for wartime research between X agency and A university. In order to "protect the Government's interest," Smith of X agency requests Jones of A university to mark outgoing shipments to Army bases in accordance with formal Army shipping instructions. Jones ignores the request on the grounds that it represents more "paper work" and "red tape." Important gear is shipped prior to the receipt of formal instructions, marked in accordance with information informally available to Jones. The gear remains at dockside for want of instructions intelligible to the loading crews until, after long delay, the shipment is traced and appropriate information forwarded. In this case, certain "paper work" was essential for effective handling. This would have been clear to Jones, as well as to Smith, had they both investigated the operations involved in handling shipments instead of concluding their discussion in the realm of abstract terms.

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[1] According to the *Century dictionary*, "red tape" is an expression derived from the once customary use of tape dyed red or crimson for tying bundles of papers used in public or private business.

As a second case, consider a peacetime research contract between Y agency and B university. Green of Y agency insists to Brown of B university that records be kept of the location and disposition of all property items valued at more than $10. No agreement can be reached while the discussion remains in the realm of "protecting the government's interest" and "paper work." Study of the agency operation reveals that Green has been instructed to apply certain property-manual rules to contracts under his jurisdiction. Study of the university operation reveals that the work involves design and fabrication of elaborate equipment into which hundreds of items are incorporated, often after considerable modification. The facts developed show that the operations requested would involve diversion of scientists and engineers from research to record keeping, that the possibility of identifying many of the items in the end product would be questionable in any event, and that there is no clear use to which elaborate records of the kind requested could be put. In this case, it appeared that the operations requested would not protect the Government's interest but would be detrimental to it. The remedy was to modify the requirements so that the actual operations involved were reasonable, would serve a useful purpose, and were mutually agreeable to the parties concerned.

These two examples, one applying and one not applying operational analysis, are based on actual situations.

Operational analysis often reveals that common procedures fail to accomplish the purpose implied by the abstract principle or policy which gives rise to them. In some instances, the reverse of the implied purpose is accomplished, as shown by the operations involved in obtaining reimbursement from the Government for expenditures under certain cost-reimbursement research contracts.

Such contracts are customarily written on a no profit-no loss basis. The university is not expected to be out-of-pocket for any expense other than those resulting from fraud on the part of one of its principal officers. As expenditures occur, the university submits vouchers to the Government, together with various "supporting papers." To "protect the Government's interest," the vouchers must be certified as to correctness and propriety by a government technical representative and a government fiscal representative. If, however, one of these officers fails to certify, and the voucher is disallowed, the university can collect payment by charging the expenditure to a special account which covers various indirect charges, such as "overhead" and other items not reimbursable under the usual vouchering procedure.

A typical series of reimbursement procedures for a no profit-no loss research contract is illustrated as follows:

(1) Z university prepares and submits voucher for purchase of pill-making machine.

(2) Government technical representative disapproves, since purchase of a pill-making machine does not appear to be relevant to the work.

(3) Z university submits reclaim, with several letters from its scientists stating need for such a machine.

(4) Government technical representative approves and forwards voucher to fiscal representative.

(5) Government fiscal representative disapproves, since cost of pill-making machine is twice usual market cost.

(6) University submits reclaim to fiscal representative with letter explaining that this is special pill-making machine, hence the extra cost.

(7) Fiscal representative disapproves because it is not sufficiently special to warrant extra cost.

(8) University charges cost of pill-making machine to account covering "indirect expenditures."

(9) Government reimburses university through account covering "indirect expenditures."

These manipulations (carried out, it must be remembered, at government expense) appear to be largely meaningless, since reimbursement in one manner or another is the usual end result, regardless of the decisions made at the various stages of the vouchering procedure. It would seem that agencies could better "protect the Government's interest" in such contractual relationships by reviewing the technical and fiscal performances of each contractor periodically, at the site of the contract. Such reviews (including on-the-premises fiscal audits) could serve as the basis for adjustments, and for changes in policies or procedures applicable to future operations.

There appears to be considerable confusion as to the operational meaning of "technical administration"—a confusion which seems to occur both within academic circles and within government agencies administering research contracts. One way to make the operational meaning of technical administration clear is to examine categorical tabulations of research problems in order of decreasing levels of abstraction, as shown below:

Abstract

Radiant energy
Effects of radiation
Biological effects of radiation
Effects of ultraviolet radiation on cells
Effects on cells damaged but not killed
Effects on damaged, living yeast cells
Chemical changes in damaged, living yeast cells
Changes in nucleotide content of damaged cells
Analysis for nucleotide nitrogen
Determination of nucleotide N by Kerr and Blish procedure

Concrete

Such tabulations indicate that each step upward in the administrative hierarchy from research worker to group leader, to research director, to government technical representative, etc., should involve decreased concern with the concrete problems of research and increased concern with the more abstract problems of choice of facilities and of research programs.

It is evidently fallacious to assume that research can be "directed" from "higher levels" by individuals who are out of contact with operational details. Scientists themselves sometimes avoid facing this issue squarely. This may be because it is difficult for scientists to admit that the more one becomes an administrator, the less one continues to be a research scientist.

Operational analysis shows that it is generally true of all organizations, whether concerned with research or with other activities, that each successive step in removal from the actual physical operations involves decreased knowledge of the details of the operation itself, and increased concern with (1) correlation of activities, (2) choice of facilities, (3) choice of persons to carry out activities, (4) resolution of broad problems of human relationships, and (5) inspirational leadership. Thus, it appears that the problems which can be attacked effectively become more and more general at higher and higher organizational levels. This implies, first, that the detailed development of policies and procedures should be initiated at the operational level and, second, that authority and responsibility should be delegated from higher to lower levels to the greatest extent possible without loss of over-all correlation.

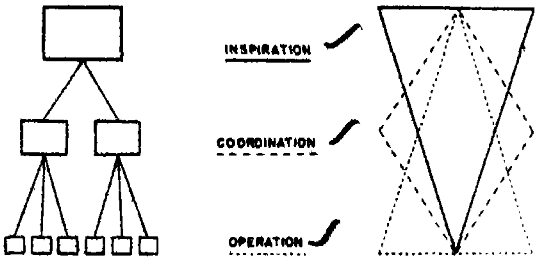

FIG. 1

At the risk of oversimplification, it is possible to indicate the functions applicable to various organizational levels by a diagram such as that shown in Fig. 1. According to such an analysis, the function of inspirational leadership is most important at the highest organizational levels; that of coordination, at intermediate levels; and that of operations directly related to the achievement of group goals, at the lowest organizational levels.

An investigation of the operational meaning of inspirational leadership impresses one with its abstract and symbolic character. A leader at a high organizational level is generally provided with a large salary and a luxurious office, is given special rights and privileges, and is included in ceremonies in which the organization or the external world joins with him in rites by which he is made to symbolize the activities and achievements of the organization as a whole. The leader, in turn, accepts certain obligations and restrictions. In arranging his life to conform with his symbolic functions, he may sacrifice considerable individual freedom.

This symbolic nature of the leader has been studied in the case of primitive tribes by Lévi-Strauss (*6*) and others. It does not appear to have been considered with particular reference to scientific leadership. As a consequence, scientists in high administrative posts are often regarded as responsible personally for "discoveries" and "advances" achieved within their organizations. The symbolic nature of public or organizational acclaim of leadership is forgotten. The individual is identified with acts which he did not and could not perform, rather than being considered as the symbol of acts carried out by other individuals within his organization. In my opinion, the fallacy that scientific research can be "directed" from above arises from this failure to understand clearly that the function of a scientific leader is largely that of acting as an inspirational symbol of the group.

Some writers assume that leadership exerts negligible influence on those concerned with actual physical operations. Such, for example, is the view expressed by Tolstoy in *War and peace*. From the operational examination of leadership, it seems that this is not the case. Positive influence seems to be exerted by leaders, but it appears to be limited largely to the conditioning of workers to the acceptance of group goals. In the paper referred to above, Lévi-Strauss makes it clear that, in the primitive society of which he is speaking, the leaders are already recognized as such by the group before they become so formally, as the chosen heads of small bands. Thus Strauss states: "The word *Uilikande*, the native word for chief, seems to mean 'one who unites,' or 'one who joins together.' This etymology suggests . . . that the leader appears as the cause of the group's willingness to aggregate, rather than as a need for central authority felt by a group already constituted."

Thus, it seems that the Tolstoyan hypothesis that the leader has no real influence on the group is fallacious. The leader is the group's symbolic representation of unity of purpose, and, as such, may exert influences (by engaging in ceremonies, issuing edicts, presenting speeches, etc.) which condition the members of the group to an acceptance of group goals. This is the reason for the differences that appear between a "weak leader" and a "strong leader"—a differentiation which would seem impossible according to Tolstoy's theory and which is yet apparent in reality.

What does operational analysis reveal about contractual relationships? Examination of the manner in which contracts are negotiated indicates that a contract is a written record of an agreement reached between various parties as to how they intend to enter into, and to carry out, a cooperative endeavor. This is consistent with the legal interpretation of the meaning of contracts, with the further stipulation that a formal contract involves a legal obligation to carry out the agreement.

Operational analysis of the contractual relationships between complex organizations, such as government agencies, universities, and subcontractors, indicates that the parties to the original agreement are not necessarily in a position to foresee the problems which will be raised by the agreement at all operational levels within their several organizations. This is illustrated in Fig. 2, where the formal contractual relationships are indicated by dashed lines and some of the additional informal working relationships by dotted lines. Thus, operational analysis suggests that contracts should not be regarded as fixed and inflexible if the most harmonious cooperative working relationships between organizations are desired. Instead, they should be regarded as modifiable by mutual agreement in so far as unforeseen or changing conditions appear to make such action advisable.

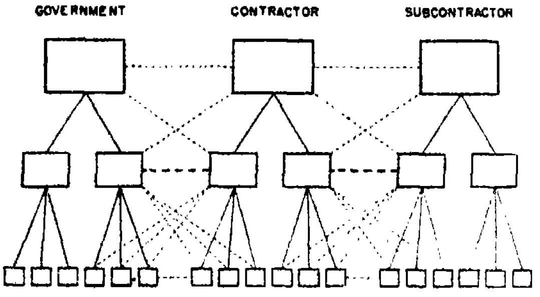

FIG. 2

Finally, operational analysis reveals certain interesting aspects of the meaning of judgments. Many administrative judgments require decisions concerning approval or disapproval of certain acts. Consider an instance in which a university contractor is required to obtain prior approval from a government representative before purchasing equipment or supplies exceeding a specified dollar value. The government representative can either approve or disapprove each case. This may lead him to attempt to apply to his decisions the law of the excluded middle, a "two-valued orientation" in which every case is considered to be either *a*, (suitable for approval) or *not-a*, (not suitable for approval). Operational analysis of the cases will reveal, however, that they extend through a more or less continuous range from those which should clearly be disapproved (being, perhaps, errors, or being totally unrelated to the contract work) to those which should clearly be approved (being, perhaps, essential and urgently needed).

Thus, examination of the operational nature of the judgments involved indicates (a) that the extreme cases can be disposed of quickly, leaving more time for consideration of the difficult middle range, and (b) that judgments with regard to the middle range involve so many factors that differences of opinion are normally to be expected. The second point is important. Hesitancy and fear in making decisions often stems from failure to realize that the use of categories in forming judgments is an arbitrary procedure, adopted for the sake of simplicity and convenience, and that the two-category, excluded-middle analysis is particularly arbitrary. Administrators who do not realize this fact are apt to worry and fret because they find so many cases which are not clearly either *a* or *not-a*.

If one operates with a system of symbols entirely removed from any relation to reality, it is possible to set up systems of operation which are strictly categorical, as in mathematics. The beauty of such abstract, completely symbolic operations is appealing. Clear rules can be set up for the operations. The correctness of any manipulation may be determined with certainty. As soon as symbolic operations are related to physical operations, however, the principle of uncertainty begins to apply.

It appears that much difficulty in administration arises from the endeavor to make the operations of judgment neat and free from uncertainty. This is accomplished by translating physical things into operational symbols—check marks on bits of paper, grades, numbers after dollar signs, etc. The operations of judgment are then carried out with the symbols, with little or no attempt to determine the operational meaning of the symbols in relation to the physical world.

This tendency appears to be especially marked in large organizations, of which the Government is an example. Extensive use is made of forms and symbols and of elaborate rules and procedures for operating with such forms and symbols. When it is realized that judgments based upon these formal operations may be inadequate, the tendency is to "back up" judgments with additional symbolic representations—memoranda, endorsements, statistical information, more elaborate forms and procedures, etc. Thus, the tendency is for symbolic operations to lead to additional symbolic operations. In extreme cases, administrative leaders may work in what amounts to a dream world of symbolism, almost completely out of touch with reality.[3] The obvious remedy is direct contact with reality. To accomplish this it is particularly essential in large organizations to delegate broad responsibilities and authorities to those who are proximate to the actual physical operations.

An attempt has been made above to show the efficacy of operational analysis as a procedure, rather than to draw specific conclusions, which, as implied by the discussion of judgments, must necessarily be relative to particular cases. There are, however, two general factors in administrative operations which the analysis of the preceding cases illustrates. One is the tendency for the extensive use of symbolic representations and abstract categorizations to insulate administrators from contact with reality. This factor can be decreased in importance by constantly emphasizing the abstract nature of symbols and by stressing the importance of relating symbols to physical operations or things. The second is the tendency to misunderstand the relationship of the leader to the group and to expect operations to be "directed" from the top because of this misunderstanding. This factor can be minimized by achieving a clear understanding of the operational meaning of leadership, whereby the functions of leaders are seen to become increasingly abstract in progression from the operational level, through the coordination level, up to the inspirational level.

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[3] Operations of this type are not unknown in academic circles. Thus, I am told that a committee, made up partly of scientists, recently awarded a scholarship to A instead of to B solely on the basis of respective cumulative average grades of 4.63 and 4.60.

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The American Philosophical Society:

Abstracts of Papers Presented at 1947 Annual General Meeting

Clinical Experience With Hemoglobin-Saline Solutions

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In collaboration with C. Martin Rhode and Mrs. Joye J. Jennings, a method has been devised for the preparation of hemoglobin-saline solutions suitable for intravenous injections in clinical cases. Injections have been made into 14 patients, 7 of whom have received more than one.

In the multiply-injected group there were five cases of secondary anemia due to hemorrhage or infection. Of these, three patients showed definite improvement after treatment, exhibiting reticulocytosis and an increase of blood hemoglobin and hematocrit values. In a fourth patient the effect of the injections could not be evaluated, since hemorrhage continued. In none of these four cases did oliguria develop. In a fifth patient the secondary anemia developed from a severe hemorrhage post partum, which led to a state of shock. Administration of hemoglobin-saline (2,300 cc. in five injections) restored blood pressure to normal. The patient appeared to be recovering, but developed oliguria and died on the ninth day. In one case of lymphatic leukemia and one of agnogenic myeloid metaplasia no improvement was observed after repeated injections. Urine flow remained normal.

In the singly-injected group no beneficial effects were observed. One patient showed oliguria, with recovery. Another patient died two hours after injection, without pyrogenic reaction or other clinical signs.

Although definite oliguria was observed in only two cases in the series, indications of renal impairment (by NPN or clearance values) were observed in three other cases, two of the multiply-injected group and one of the singly-injected group. In the last-mentioned patient, after injection of 200 cc. of hemoglobin-saline, both glomerular filtration rate, as measured by mannitol clearance, and renal plasma flow and Tm, as measured by PAH clearance, were reduced to about one-third of the original values, with later recovery to normal. Liver function tests remained normal in the three cases tested.

In most cases the solutions exert a pressor effect which endures for several hours. The rise in blood pressure is accompanied by bradycardia.

In some cases injections up to a volume of 500 cc. (= 50–60 grams hemoglobin) have given no rise in temperature or other reactions. In other cases usually mild, but occasionally severe, pyrogenic reactions, complicated by other reactions, have been observed.

No evidence of anaphylactic reactions caused by hemoglobin was observed in any case.

The solutions do not agglutinate cells of the four main blood groups.

Methemoglobin does not accumulate in the plasma, even after large injections of these solutions.

In 6 patients the average amount of hemoglobin which appeared in the urine was 18 per cent of that injected.

New Effects in Superconductivity

Donald H. Andrews
The Johns Hopkins University

With the aid of a grant from the American Philosophical Society, an investigation was undertaken in 1938 to survey the possibilities of using superconducting metals as electrical thermometers for measuring very small amounts of thermal energy. During the recent war a need arose for fast-acting devices for measuring small pulses of infrared radiation, and it was found that bolometers capable of measuring as little as 10^{-6} ergs in 10^{-3} seconds could be made of superconducting alloys. This corresponded to temperature changes of the order of 10^{-7} degrees. It appeared that the infrared was absorbed directly in the superconductor with a coefficient of about 60 per cent, contrary to the expectation that a superconductor might be a perfect reflector.

The sensitivity of such bolometers was limited by the inherent thermal fluctuations in the superconductor. By observing the fluctuations in strips of columbium nitride, it was found that just above the superconducting transition the random fluctuation had a peak-to-peak average of 0.01 μv when a current of 1 Ma. was passing through the metal. When the temperature was lowered into the superconducting transition zone, the random fluctuation, or "noise," increased in amplitude about threefold. Studies with currents ranging up to 5 Ma. showed that noise increased roughly proportionately to the current. Observations with zero current showed that the noise in the normal state still increased by a factor of several fold when the metal passed through the transition, decreasing again when the metal was completely superconducting. The noise level is thus an indication of the state of the metallic electrons even when zero current is passing.

Exploring the phenomenon further with the aid of a loud-speaker, it was found that the character of the noise as perceived by the ear changed sharply in the transition, so that one could thus distinguish the passage of the metallic electrons from one state to another. While carrying on these experiments it was discovered that, in certain narrow regions of temperature, the voices from local commercial broadcast programs were heard on the loud-speaker. To explore this effect further, radio-frequency signals were generated in the laboratory in the range of 0.1–30 Mc. In several frequency bands in this range the reception was of a much higher intensity than in other ranges. Holding frequency constant and varying temperature, one finds again a series of "temperature" bands in which detection takes place, starting in the middle of the superconducting transition and extending considerably below it. The number of bands increases with increasing current. The position of the first band on the temperature scale appears to be independent of radio frequency over the range of study. The height of the first band goes through a continuous increase from zero current to 0.4 Ma., passing to a maximum and then decreasing.

Since the bands which appear with heavier current are found in a region removed over half a degree from the transition, there seems to be evidence for sharply temperature-sensitive phenomena of a new kind associated with superconductivity in ranges where hitherto only temperature-insensitive phenomena have been observed.

Biochemical Mechanism of Cellular Oxidation

Eric G. Ball

Harvard University Medical School

The human body at rest uses about the same amount of energy as a 100-watt electric light bulb. Like the bulb, the body obtains this energy by a process which involves the flow of an electric current. In the living cell, electrons flow from the foodstuffs we ingest to oxygen, thus reducing the oxygen to form water. The "filament" of the cell over which these electrons flow is not of uniform composition as it is in a light bulb. The electrons in the cell are passed along over a chain of compounds composed of iron-containing proteins, the cytochromes, and vitamin-containing units named coenzymes. The over-all process involves a potential change of about 1.17v and a total flow of current in all the body cells which amounts to about 76 amp. The process occurs, however, in a stepwise fashion which involves five or six successive transfers of electrons between the various components comprising the cellular "filament" or oxidative chain. Each pair of components may thus be looked upon as forming a battery, the pairs being connected in series. A drop in voltage occurs with the interaction of each pair in this series; its magnitude may be estimated from our knowledge of the oxidation-reduction potentials of each of the systems involved. How the energy released at each of these interactions is utilized by the cell is not exactly known. A good portion of it, however, seems to be converted into high-energy phosphate bonds which, in turn, directly supply the driving force for many of the various physiological processes which constitute life.

The Nürnberg Trial

The Honorable Francis Biddle

Former Attorney General of the United States

The Nürnberg trial was a military proceeding, and therefore representatives of the victorious powers only sat on the Tribunal. The defendants could have been given "political" treatment (punishment without trial), but this would have imitated the Nazi methods for which they were being called to account.

The principles of both the Charter, to which 23 nations adhered, and the Judgment were approved by the General Assembly of the United Nations, which has begun, very tentatively, the formulation of an International Criminal Code based on these principles.

The doctrine of *nullum crimen sine lege* is not a limitation of sovereignty, but a general principle of justice. The question was therefore not whether it was lawful, but whether it was just, to try Goering and his associates on the charge of launching aggressive war. That aggressive war was considered a crime before the Pact of Paris was adopted was generally recognized. International law is not the product of an international legislature but gradually develops in the customs of states.

Another important principle of international law recognized by the Judgment was its application to individuals who could not shield themselves by the doctrine of state sovereignty when the state had moved outside its competence.

The Tribunal narrowed the broad theory of conspiracy to wage aggressive war advanced by the Prosecution and found only 11 defendants guilty on this count. The Judgment approached with great caution the Prosecution's request that the Tribunal declare criminal certain named organizations and, as to those three which it did declare to be criminal, included in the definition of membership only persons who joined voluntarily and knew of the criminal purpose.

The Soviet dissent was not based on a disagreement as to any general principle adopted by the majority, but simply on a different interpretation of the facts with respect to the three acquittals, and the three organizations not declared to be guilty.

The West Coast Corridor: A Chapter in the Northward Expansion of Mexico

Herbert E. Bolton

Sather Professor Emeritus of History
University of California

Ever since the Spanish conquest in the 16th Century a vase area in northern Mexico open for colonization has been a spur to the initiative of people from the more crowded regions farther south. Turner wrote a brilliant monograph on the significance of the frontier in the development of society in English North America. It would be interesting to consider to what extent his thesis is applicable to the history of Mexico.

The place in which European and native have had longest and most vital contacts is in the central and southern area, where the native peoples had achieved a high civilization. Here, after the conquest, the first new Spain and first new Mexico, with vital elements from each of the parent stocks, were formed. Here Spanish law and native custom first operated side by side on the same terrain.

Meanwhile, a new chapter in Mexican history was begun. The area of Spanish settlement was extended northward into regions occupied by natives representing a relatively primitive society—peoples whom the Spaniards called *Chichimecos*. Here the historical process after the conquest was fundamentally different from that further south.

Beginning north of Vera Cruz on the Gulf of Mexico, the line between these two cultures ran generally westward, passing north of Mexico City and Guadalajara, to Tepic, and thence north to Culicán. South of this line lived the sedentary, and north of it the nonsedentary, peoples.

Spanish colonization north of the line proceeded in three columns, determined by two great mountain chains, the Sierra Madre Oriental and the Sierra Madre Occidental, natural barriers which divide the northern expanse into distinct geographical provinces: the East Coast Corridor, the Central Plateau, and the West Coast Corridor. The Sierra Madre Occidental, so rugged that for nearly 1,000 miles north of Tepic it has seldom or never yet been crossed by a wheel track, spectacularly isolates the West Coast Corridor. Nevertheless, the salient has had great significance.

The Diffusion and Influence of Locke's *Essay Concerning Human Understanding* in France Before Voltaire's *Lettres Philosophiques*

Gabriel Bonno
University of California

Contrary to Voltaire's claim, his *Lettres philosophiques* (1734) did not initiate in France the diffusion and influence of Locke's *Essay concerning human understanding*.

Before 1700 this diffusion begins with articles in the French periodicals published in Holland: a long outline of the *Essay*, two years before its publication, in Leclerc's *Bibliothèque universelle*; reviews of the first four English editions of the book; and references to the discussion of the *Essay* in England, particularly to the controversy between Locke and Stillingfleet. In 1700 Coste's French translation of the *Essay* quickens the diffusion of Locke's thought on the Continent. In the following years attention is drawn to the *Essay* by various publications: French translations of Locke's *Posthumous works* and of Wynne's *Abridgement* of the *Essay*; frequent references to Locke in the widely read translation of the *Spectator*; Desmaizeaux' *Recueil philosophique*, containing comments of Leibniz on the first two books of the *Essay*; and a long article on Locke by Nicéron in his *Mémoires*. The interest in the *Essay* is evidenced by many references of French writers: Locke's rejection of innate ideas is criticized by d'Aguesseau and Polignac, but approved by Bayle, Fréret, Boulainvilliers, Lévesque de Burigny; Locke's statements on thinking matter are questioned by Bayle and by the Jesuit editors of the *Mémoires de Trévoux*.

The influence of the *Essay* is particularly significant in the case of three French writers: DuBos, in his *Réflexions critiques* (1719), applies the empirical and sensualistic method of Locke to the field of aesthetics; in his *Théorie des sentiments agréables* (1729), Lévesque de Pouilly develops the element of hedonism implied in Locke's analysis of pleasure; in his *Traité des premières verités* (1724), Buffier mitigates the rationalistic tendencies of Locke in religious matters, but closely follows him in the matter of inneism and in the analysis of simple or complex ideas.

Do Judges Make or Discover Law?

Zechariah Chaffee, Jr.
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Two English judges started this controversy in 1345: "Law is the will of the Justices." "No, law is that which is right." Blackstone says a judge must not "pronounce a new law, but . . . expound the old one." Holmes ridicules Blackstone. "The common law is not a brooding omnipresence in the sky, but the articulate voice of some sovereign. . . . "

The controversy over whether judges make case-law as legislators make statutes affects at least five practical questions: (1) Is a transaction which is valid or lawful by a previous decision rendered otherwise by a subsequent decision overruling the first decision? (2) Congress orders a Federal judge to decide a case between citizens of different states, involving no Federal issue, according to "the laws" of the state. May he disregard a state court decision squarely in point and find what would be a better nation-wide rule in precedents elsewhere? (3) Is a state decision holding criminal an act which was not criminal by cases before its commission an "ex post facto law"? (4) If, in an action on a contract, a state court grants a defense unrecognized by the state's case-law before the contract was made, is this decision a "law impairing the Obligation of Contracts"? (5) Is a state decision enunciating an arbitrary unreasonable rule of substantive law a deprivation of life, liberty, or property by the state, violating the 14th Amendment?

Detailed examination of cases in these five situations shows some supporting Blackstone's theory of what judges do and some Holmes's. Reasons of practical policy might justify the results apart from choice of either theory.

Probably courts will never adopt either theory wholeheartedly. Holmes's "sovereign" is unreal like Blackstone's impersonal common law. Yet each theory contains some truth which cannot be rejected. A possible compromise is: Judges make law out of what they discover. Law is the will of the Justices trying to do that which is right.

The Place of Science in the Program of UNESCO

Arthur H. Compton
Chancellor, Washington University

The first important activities of UNESCO must necessarily be in fields which are welcomed by all nations. They should also lead demonstrably toward a peaceful adjustment of world society. These conditions are most fully realized in science and its applications. UNESCO has accordingly planned an active program in science.

Where two nations have ideological differences that bring danger of war, many types of interchange of ideas are unwelcome or subject to suspicion. This applies in particular to the use of radio and the press, to the control of basic education, and to religious and philosophical thought. No such difficulty exists in the field of science. Since, for securing the peace of the world, it is precisely between nations with such differences that it becomes most important to obtain understanding and cooperation, scientific education and research become leading aspects of UNESCO's task.

Its science program includes: (a) rehabilitation of science education in devastated countries; (b) international exchange and conferences of scientists and technologists; and (c) promotion of research programs of international concern.

The rehabilitation of scientific activities will be undertaken by surveying the actual needs and by stimulating the creation of agencies to collect and distribute needed equipment and books. Also, enabling scientists to go for a limited period from exhausted countries to those where scientific study is active will serve to keep alive the scientific thought of these countries while their own institutions are being re-established.

Typical of the active research that will be sponsored by UNESCO is that of the effects of various types of prolonged malnutrition on the large populations of India and China. A related program is the study of the conditions for satisfactory living in the equatorial forest zone. As a concrete beginning, UNESCO will coordinate the researches by specialists from many nations on the resources and conditions of life.

Medical Treasures in the Library of the American Philosophical Society

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Medicine has always been considered by the American Philosophical Society to be one of the cultural-scientific branches of learning worthy of its attention. When the Society was founded in the 18th Century, men of general learning included medicine among their interests. Franklin, for example, had a number of medical volumes in his personal library. At the same time biology, zoology, and chemistry were professionally cultivated largely by the physicians. Not only were leading doctors elected to the Society, but many famous British and European physicians were honorary members. These men often contributed their works. The early librarians, Vaughan and Ord, purchased medical books. In later years there have always been medical members, and the presidential chair has several times been filled by physicians. The Society's library reflects this tradition, and, thus, although its medical books by no means form a systematic collection, they include many distinguished items, including rare American pamphlets by John Tennant (1740) and Benjamin Waterhouse (1800); works donated by eminent foreign members, including Jenner, Erasmus, Darwin, Lettsom, and Franklin's young friend, William Hewson; the Edinburgh dissertation of John Morgan, founder of the Medical School of the University of Pennsylvania; medical works of the early republic, such as those by Matthew Carey on the yellow fever of 1793 and by Currie on the climates of the U. S.; books by Benjamin Rush, and the *Anatomy* of Caspar Wistar; and such medical classics as Johnson's translation of Paré's works (1678); the anatomical plates of Eustachius (2nd ed., 1744) with the autograph of Abraham Chovet, Philadelphia's first anatomist; Withering on Foxglove (1785); and Cruikshank on the lymphatic vessels (1786).

The American Idea of Progress: 1750–1800

Rutherford E. Delmage
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The idea of progress was Americanized during the latter part of the colonial period and became more popular and more widely disseminated between 1750 and 1800. The American idea of progress had a relation to the Christian dream of the millennium (Samuel Sewall), to the increasing secularization of thought (Nathaniel Ames), to a genetic philosophy of history (William Douglass), to the development of science (American Philosophical Society), and to the rationale colonization. That Georgia is "capable of great improvements" was a main argument used by the trustees of that colony in 1733.

Leading thinkers of the American Revolution and early republic—Benjamin Franklin, Thomas Jefferson, George Washington, Tom Paine, and others—entertained great faith in the political progress of the United States. Optimistic affirmation, a firm belief in the new nation's potentialities of development, provided a dynamic to motivate American civilization from the time of its inception.

Richard Henry Lee of Virginia, John Rodgers of New York, John Witherspoon of New Jersey, James Wilson of Pennsylvania, David Ramsay of South Carolina, Samuel E. McCorkle of North Carolina, Joel Barlow of Connecticut, and John Lathrop and Francis Blake of Massachusetts are representative writers cited to illustrate the pervasiveness of the idea of progress (especially political progress) in the United States before 1800. The American awareness of the idea of degeneration and of the cyclical theory of history is also mentioned briefly.

Contributions of Physiology to Problems of Industry

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Harvard University

Industry has profited greatly from physiological research in the past, and yet the possibilities of applying this science to industrial problems are not yet fully appreciated. The failure of labor and management to make full use of physiology depends in part on the methods of teaching this science. It is generally regarded as a hand maiden of medicine, thought and research being concerned largely with the physiology of the diseased man rather than with that of man in his everyday life. Hence, it is natural for medical men in industry to devote much of their energy to care of traumatic injuries, to safeguarding the interests of the company in so far as insurance is concerned, and to supervising toxicologists and hygienists who are responsible for control of industrial hazards.

The fields in which physiology, as applied to man at work, is making itself felt in recent years are nutrition, energy exchange (as related to fatigue, rest periods, and hours of work), temperature regulation (e.g. the roles of salt and water in reducing heat casualties), and various aspects of the physical environment, including particularly illumination, color, noise, and vibration. Research in these fields could be applied by both labor and management to their mutual satisfaction.

Research in human physiology deserves the support of both industry and labor. In war and in peace the expenditures for physiological research in this country have been trifling when considered in the light of the gains in the physical fitness and productivity of labor. The following questions require long-range research for even an approximate solution: To what extent does the health and well-being of workers depend on the physical environment? What is the relation between physical fitness, the quantity of food eaten, the distribution of meals, and the amount of exercise? Are physical standards of our population lowered by wearing poorly fitted and designed shoes, particularly during childhood and youth? Are there potential hazards in luxus diets that are unnecessarily rich in vitamins, sugar, dairy products, or calories?

Benjamin Franklin, The American Philosophical Society, and the Russian Academy of Science

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Very little is known about American-Russian cultural relations in the 18th Century. Their beginning is linked with the name of Benjamin Franklin and the American Philosophical Society.

Franklin's name was first mentioned in the Russian press in 1752, and the "Minutes" of the American Philosophical Society mentioned the Russian Academy for the first time in 1771; but the fact that Franklin was in direct contact with Russian academicians was ignored until recently, when Dr. Dvoichenko-Markoff discovered documents containing irrefutable data, bearing witness of the continued relationship between Franklin and several Russian scholars. These documents establish the probability of Franklin's contact with the Russian academicians, Epinus and Braun—the first scientific connection between America and Russia.

In 1773 and 1777, respectively, Franklin became personally acquainted with two Russian scholars, Baron de Klingstedt and Prince D. Gallitzin. Baron Klingstedt became the first Russian member of the American Philosophical Society.

On the basis of letters discovered in the Archives of the American Philosophical Society, Dr. Dvoichenko-Markoff established the year 1781 as the date of Franklin's personal acquaintance with Princess Dashkaw, president of the Russian Academy and the second Russian member elected by the American Philosophical Society, in 1789, on Franklin's recommendation; the same year Franklin was elected as the first American member of the Russian Academy, on Princess Dashkaw's recommendation.

The impetus given by Franklin and Princess Dashkaw to Russian-American cultural relations continued to bear fruit even after their death, and the American Philosophical Society remained in close and constant contact with Russian scientific societies and with individual representatives of the cultural elite of Russia.

Reinterpretation of the Glacial History of Iowa Based on Studies in Greenland

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Glaciers which, in Pleistocene time, blanketed northern North America left deposits which heretofore have been interpreted as though the glaciers which laid them down had been enlarged examples of the small Swiss glaciers, those best known when the theory was first promulgated a century ago.

Glaciers of continental dimensions which must resemble the Pleistocene examples are, however, today over Greenland and Antarctica. Studies carried out by expeditions from the University of Michigan on and about Greenland glacier in the years between 1926 and 1932 show them to be essentially different in their nature and in their deposits from the Alpine ones. This newly acquired knowledge has made it necessary to reinterpret the Pleistocene glacial history, with results quite different from those which have heretofore been accepted. Both the number of successive glaciations and the areas which each covered have had to be altered materially.

The present study, first undertaken in 1943 with aid of a grant from the Society, treats especially of glaciation within and around the state of Iowa.

Zebulon Montgomery Pike and the Wilkinson-Burr Conspiracy

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For more than a century and a quarter American historians have been intrigued with the southwestern expedition of Zebulon Montgomery Pike and its relation to the famous Wilkinson-Burr conspiracy. Lt. Pike was ordered to explore the sources of the Arkansas and Red Rivers by Gen. James Wilkinson, military governor of Upper Louisiana in 1806. The United States had recently purchased Louisiana, and Jefferson had sent Lewis and Clark into the far Northwest on a scientific and exploratory expedition. Pike's journey into the Southwest, ostensibly for the same purpose, was ordered by Gen. Wilkinson and not by Congress or the Executive.

When Pike's party was discovered by the Spaniards encamped on the west bank of the Rio Grande, the men were arrested and taken to Chihuahua. The Spaniards eventually released them, and Pike returned to the United States in July 1807, only to learn that his friend and promoter was involved in some way with the Burr conspiracy and at that time was a star witness against Burr at the trial in Richmond, Virginia.

Wilkinson's reputation suffered to such a degree that he was never able to remove the cloud of suspicion surrounding his motives in the Southwest and his relationship with Aaron Burr. Pike was suspected of collaboration with the General by allowing himself to be captured by the Spaniards in order that he might better obtain information that would be helpful to the schemes of Burr and Wilkinson. There is sufficient proof against Wilkinson to convict him of treason, but Pike can only be convicted upon circumstantial evidence.

Many people then and now believe that the young explorer knew more about the affair than he pretended. Several questions with regard to his conduct are yet to be answered, but a careful examination of all of the available materials leads one to the conclusion that his greatest fault was his lifelong friendship for Gen. Wilkinson. Insufficient proof exists that he was knowingly connected with the Wilkinson-Burr episode. After 19 years of creditable service in the U. S. Army, Pike was promoted to the rank of brigadier general in 1813, only to lose his life a short time later in the siege of York. He was 34 years of age at the time of his death.

High-Altitude Research With V-2 Rockets

Ernst H. Krause

Rocket Sonde Research Section, Naval Research Laboratory

The high-altitude research program utilizing V-2 rockets, which has been going on at White Sands Proving Ground in New Mexico during the past year, is discussed in some detail. The method of recovering data including telemetering, parachute, and physical recovery is reviewed. Data obtained to date in the fields of cosmic rays, solar spectra, pressure and temperature of the upper atmosphere, and ionosphere measurements are emphasized.

The experiments in cosmic rays have verified the presence of a large, hard component in the primary radiation. In addition, a component has been found at high altitudes, consisting of a soft radiation presumably due to upward-moving particles. The possible presence of other components in the primary radiation is also discussed.

Solar spectra have been obtained on two different V-2 flights, both of which extended the solar spectrum down to about 2,200 A. The significance of these data and their bearing on such things as the black body theory of the sun, the ozone content of the atmosphere, etc. have been analyzed in part.

Pressure measurements have been taken up to about 100 kil. These measurements have involved mainly the use of bellows, Pirani, Philips, and ionization gauges. Ambient temperatures of the atmosphere at various altitudes have been obtained mainly from pressure data. Skin temperatures at various points on the rocket have been measured throughout most of the V-2 trajectory.

Measurements of ion density in the E layer of the ionosphere were made by means of a phase beat method. Two harmonically related frequencies, one near critical, are radiated from the missile to a ground station. The beat between two received frequencies on the ground is a measure of the ion density at the transmission point. The significance of the results so far obtained are discussed.

The Genesis and Reception of Jefferson's *"Notes on Virginia"*

Marie Kimball

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Early in 1781 Jefferson received from the Marquis de Barbé-Marbois, secretary of the French legation, a paper containing "sundry inquiries into the present state of Virginia." After his retirement as governor in June, Jefferson set about ordering the loose memoranda he had been collecting for years and preparing answers to M. Marbois' questions. The result was not a series of hasty observations but a learned treatise on his country. Everything that could be said or known about Virginia in the last quarter of the 18th Century is embraced in this slender but compact little volume.

On his election to the Council of the Philosophical Society this same year, Jefferson wrote Charles Thomson that "in framing answers to some queries Mr. Marbois sent me, it occurred to me that some of the subjects which I had then occasion to take up might, if more fully handled, be a proper tribute to the Philosophical Society." Thomson replied that he was persuaded that Jefferson's reflections "would be a very acceptable present to the Society." "This country affords to philosophic view an extensive, rich and unexplored field," he writes. "The mind of man is just awakening from a long stupor of many ages . . . and I congratulate posterity on the advantage they may derive from your philosophical researches." Thomson's subsequent comments on the *Notes* were ultimately printed as an appendix.

The demand among his friends to see the *Notes* was such that Jefferson decided to print a few copies. Finding this impossible in Philadelphia, he carried them with him to France, and the first printing was completed in May, 1785. A threatened pirated edition in French led to a translation by the learned Abbé Morellet. He proposed a map, which Jefferson prepared, and the French edition appeared in 1787. An English one, sponsored by Jefferson and published by John Stockdale, came out in the same year, as did an unauthorized one in America.

The *Notes* met with a warm reception, but contemporary published comment is not abundant. The *Monthly Review* of London (1788, Vol. 77) contained a somewhat condescending notice. A careful reading of the leading French scientific journals of the time has failed to reveal any notice of the work. The *Mercure the France*, however, the leading periodical of the French capital, in its issue of June 2, 1787 and the following one, devotes 23 pages to a review, which has not hitherto been brought into conjunction with the *Notes*.

Are the Jews a State or Are They a Religion?

Lessing J. Rosenwald

Chairman of the Trustees, Rosenwald Fund

The struggle in which the world finds itself engaged—that between the forces making for a "one world" concept and the forces of fragmentization in terms of racial, religious, and nationalist divisions—is reflected among Jews. In the near future, a choice will have to be made by Jews themselves and by the world at large with regard to what the status of the Jew is to be. The choice is between a universal concept of Jews as free and equal citizens throughout the world, adhering to an ancient religion, and that of Jews as a nation centered in Palestine.

The basic elements in that choice go back to the days of destruction of the Hebrew Commonwealth in Palestine. During the centuries that Jews were confined to the ghettos of Europe they had no choice. Only the gradual removal of their disabilities following the French and American revolutions and the expanding concept of democratic ideas gave the Jews freedom of action on that choice.

For a long time there was every indication that the choice would be in behalf of the universalist concept. Two forces, however, emerged to reverse this trend. One was the development of a different concept of society: the racialist, tribalist, blood-and-soil concept that developed in Germany. The other was the continuance of anti-Semitism, which led to a sense of defeat and hopelessness among Jews.

The Palestine problem is a culminating manifestation of the conflict. It has been complicated by the agonizing experience of the Jews of Europe: by their savage destruction under the Nazis and the sorrowful existence of Jews among the Displaced Persons. The conflict, however, remains based upon two divergent concepts, and its resolution must be made primarily by Jews themselves. The non-Jewish world can contribute to a wise choice by Jews by a thorough understanding of the real issues, by helping in the solution of the Displaced Persons problem, and by fighting the illiberalism of anti-Semitism.

The Future Industrial Position of Oxygen

Earl P. Stevenson

President, Arthur D. Little, Inc.

Oxygen can lay claim to being the most useful as well as the most abundant of the chemical elements. The ingenuity of the chemist and the engineer has made oxygen available during the past 50 years in forms other than that directly supplied by nature, and there have been recent significant advances in this art which will open up other man-made uses. Air and water are the major industrial chemicals; no element rivals oxygen in industrial importance.

With the application of rectification to liquid air by Linde in 1902, oxygen of high purity became available and, in this form, has assumed increasing importance in industry in the intervening years. Tonnage uses in the process industries have not developed, however, for highly concentrated oxygen (99–99.5 per cent) because of the high investment and operating costs involved in the liquefaction and separation of air. Yet the theoretical minimum work requirement for separating oxygen from the air is insignificant, being only .032 hp/pound of oxygen/hour. The difference between theory and practice has been a challenge to which the engineer until recently has not been too responsive. Development work undertaken during the war advanced this art, and several very important industrial applications for tonnage oxygen are now in immediate prospect. These will involve the construction of very large separating plants. Single plants in some of these new applications will equal in producing capacity the total of the prewar production of oxygen in this country. These applications are among the most exciting new developments in industry with both evolutionary and revolutionary portent. At the same time there is a steady growth in the general industrial uses of oxygen.

Uses of the Separated Stable Isotopes of Oxygen

Hugh S. Taylor

Dean, Graduate School, Princeton University

Oxygen exists in three stable isotopic forms of masses 16, 17, and 18 with natural abundance of 99.76, 0.04, and 0.20 per cent, respectively. Only the isotope of heaviest mass (18) is thus far significant for isotopic studies. Oxygen is one of the most important and frequent elements in inorganic, organic, and biological compounds. The heavy isotope can be used to test the stability of oxygen bonding with other elements in inorganic compounds containing such oxyacids as carbonate, sulfate, sulfite, phosphate, phosphite, etc. Heavy oxygen can be used as an important tool to study the activity of catalysts in oxidation processes. In organic chemistry the heavy oxygen isotope can be used to test the relative strengths of the two bonds which oxygen makes with any two other atoms or groups, as generalized by the formula $R—O—R'$. In this way, old controversies concerning the mechanism of formation and hydrolysis of esters have been solved. As an important constitutent of sugars, carbohydrates, amino acids, and proteins, oxygen, in its heavy species, can be used to test hypotheses of biological importance. An illustration of this use is the investigation of photosynthesis by plant life, from which it is concluded that the oxygen in the carbon dioxide is built up into the plant structure, whereas the oxygen in the water consumed is given off by the plant as elementary oxygen. In the whole field of growth generally, the use of heavy oxygen will play an increasingly larger role.

Hitherto, the amounts of heavy oxygen available have been pitifully small and the difficulties of research correspondingly magnified. The techniques of isotope separation developed by the Manhattan District permit the separation of heavy oxygen with ease, efficiency, and in large amounts whenever a decision to proceed is made and the expense involved is underwritten. Since radioactive isotopes of oxygen are not available, the problem of large-scale separation of the stable isotopes of oxygen is of major importance for the further rapid progress of tracer work with oxygen in biological systems, and should be special objects of concern to those interested in the problem of growth.

The *Kline* of Sarapis

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Our information concerning the *kline* or cult banquet of Sarapis is meager. The documentary material, consisting of papyri and inscriptions, is limited in scope, and the literary allusions are vague. The invitations to private *klinai* at Oxyrhynchus are noncommittal; the expansive eulogy of Aristides consists almost entirely of enthusiastic acclaim of the god's fellowship. A hitherto unedited papyrus of the early 3rd Century A.D. from Karanis, now in the Michigan collection, makes a substantial contribution to our knowledge of the institution. It is a letter written by a young man away from home, probably living at the Serapeum in Memphis, to his father, who resided in Karanis. The writer informs his father and mother that the *kline* of Sarapis, sponsored seemingly by the priesthood of the temple, is open to him at the cost of 22 drachmae for his place at the banquet and 24 drachmae for participation in the mysteries. The association of mysteries with the banquet rests on an interpretation of an uncommon adjective derived from a common Greek noun, taken together with Aristides' brief references and the logical implications of Sarapis' commanding position in the religious world at this time. The banquet is stated to be two months off, and the writer obviously intends to remain at the temple until that time. In order to avoid payment of the fees he will perform certain services. This situation raises a number of questions, for which an answer is sought, regarding his status at the temple and a possible connection of the *kline* with the *katoche* of Sarapis, an institution well known to us at the Serapeum of Memphis in the Ptolemaic era.

NEWS *and Notes*

During the dry seasons of 1946 and 1947 Alexander Wetmore, secretary of the Smithsonian Institution, has made brief expeditions into eastern Darién to study the bird life of that area. The region lies on the Pacific side of the Republic of Panamá, near the frontier of Colombia. It is thus on the threshold of the Chocó region of northwestern Colombia. The distance involved and the prevalence of malaria have until recently made this region relatively inaccessible.

In 1946, with Watson M. Perrygo, of the National Museum, as assistant, Dr. Wetmore concentrated on the coast at the mouth of the Río Jaqué, making collections, principally of birds, and simultaneously carrying on studies of the migration of North American birds to South America in our winter season. Here also he established friendly relations with the Chocó Indians, who came down river from the interior. This year, on invitation from these Indians, Dr. Wetmore and Mr. Perrygo returned to Jaqué, traveling into the mountains in dugout canoes poled by the natives through the rapids to the head of navigation. Hunting trails were cut in the forests surrounding the camp, and other areas were reached by Indian trails. The collections of birds made on this expedition, now in the National Museum, fill in gaps in distribution and add to knowledge of the life of the region.

About People

Six leading U. S. scientists are now in Japan on a 30-day visit made at the request of the War Department and sponsored by the National Academy of Sciences. This group, which will assist in evaluating plans submitted by Japanese scientific organizations for the democratization of scientific research in that country, includes **Royal W. Sorensen,** head, Electrical Engineering Department, California Institute of Technology; **William V. Houston,** president of Rice Institute; **Roger Adams,** head, Department of Chemistry, University of Illinois; **William J. Robbins,** director, New York Botanical Garden; **William D. Coolidge,** director emeritus of research, General Electric Company; and **Merrill K. Bennett,** executive director, Food Research Institute, Stanford University.

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Harley P. Brown, Department of Zoology, University of Idaho, has been appointed to the staff of the Department of Biology, Queens College, Flushing, New York.

Waldo Shumway, since 1922 a member of the staff in zoology, University of Illinois, will become dean at Stevens Institute of Technology, Hoboken, New Jersey, on September 1.

Otto Degener, author of *Flora Hawaiiensis*, addressed the Hawaiian Botanical Society May 5 on "Plant Hunting in Fiji." As guest botanist on Mrs. Anne Archbold's second expedition in her 100-foot junk-yacht, *Cheng Ho*, he discovered the flowers of the new plant family *Degeneriaceae* on the island of Viti Levu. The *Cheng Ho*, sold to the Navy in 1941, has been repurchased by Dr. Degener in Honolulu for use in further explorations in the South Seas. Scientists interested in joining such trips are requested to communicate with Cdr. J. P. Norfleet, Cape May, New Jersey.

I. Forest Huddleson, research scientist at Michigan State College, in a paper presented before the recent International Congress for Microbiology in Copenhagen, told of a new treatment for undulant (Malta) fever which involves a new application of the sulfa drugs. Whole blood is injected into the patient's system, sulfadiazine then being administered in small amounts for one week. It is Dr. Huddleson's hope that he may be able to perfect a compound that will make it possible to inject both drug and antibodies simultaneously into the bloodstream without the necessity of relying on a blood bank. The new treatment, which may also prove successful in other infectious diseases, is based on his original theory that the drug does not actually destroy the germs but increases the action of the antibodies in the serum which, in turn, kill the harmful bacteria.

Colleges and Universities

The Centennial of the Sheffield Scientific School, Yale University, will be celebrated on October 15–17. On the first two days of the ceremonies a series of four Silliman Lectures will be given by Ernest O. Lawrence, professor of physics, University of California; Linus C. Pauling, professor of chemistry, California Institute of Technology; Wendell M. Stanley, of the Rockefeller Institute, Princeton, New Jersey; and George W. Beadle, professor of biology, California Institute of Technology. On October 17 there will be a University Convocation, at which President Seymour will confer honorary degrees upon candidates presented by Edmund W. Sinnott, director of the School, who will be public orator. The address on this occasion will be given by Dean Emeritus Charles H. Warren. Throughout the celebration those present may view a series of exhibits, located in the Sterling Memorial Library and depicting the history of the School and of science at the University. The Centennial is coincident with a fundamental reorganization of the Sheffield Scientific School. The undergraduate bodies and faculties formerly divided between the sciences and the humanities have been consolidated, and the School has now become the Division of Science of the University, responsible for graduate instruction and general promotion of science.

Meetings

The Fourth International Cancer Research Congress will be held in St. Louis, Missouri, September 2–7, under the sponsorship of the American Association for Cancer Research and the Union Internationale Contre le Cancer. Attempts are being made to cover the most important aspects of cancer research both in clinics and laboratories. Papers will be read and discussed, exhibits will be shown, and moving pictures will be presented. Headquarters will be at the Hotel Jefferson, 415 North 12th Street. All those interested will be cordially welcome.

Special invitations are unnecessary. A registration fee of $10.00 will be charged to help defray the expenses of the meeting. The U. S. Department of State has transmitted formal invitations to all Governments with which the United States has diplomatic relations, asking them to send official delegates to the Congress. In addition to these official delegates, many leading cancer investigators will come from abroad and represent their governments informally. As of July 22, representatives of 29 nations had decided to attend. A total attendance of about 1,000 is expected, chiefly from the United States. Information can be obtained from The Fourth International Cancer Research Congress, 3427 Washington Avenue, St. Louis 3. To make hotel reservations, apply to the St. Louis Convention Bureau, 911 Locust Street, St. Louis 1.

The International Statistical Conferences, to be held in Washington, D. C., September 6–18, will bring a number of foreign biometricians to this country. None of the sessions in Washington, however, is specifically biological. To fill this need, a small committee was named last April by D. B. DeLury, chairman of the Biometrics Section, American Statistical Association. Following a preliminary survey, the committee decided in favor of an informal conference to be held on Friday and Saturday, September 5–6, at the Marine Biological Laboratory, Woods Hole, Massachusetts. Invitations have been sent to the delegates to the International Statistical Conferences interested in biometry and to other foreign quantitative biologists.

It was clear that this First International Biometric Conference should be sponsored by an Organizing Committee which would be broadly representative of the sciences contributing to quantitative biology. Because biometry applies to the fields of several of its Divisions, the National Research Council has named two representatives on the Committee. The Committee includes: A. F. Blakeslee, Smith College; C. I. Bliss, Connecticut Agricultural Experiment Station; W. G. Cochran, North Carolina State College; E. J. deBeer, Wellcome Research Laboratories; H. K. Hartline, University of Pennsylvania; H. W. Norton, U. S. Weather Bureau; N. Rashevsky, University of Chicago; E. W. Sinnott, Yale University; J. W. Tukey, Princeton University; John von Neumann, Princeton University; and E. B. Wilson, Harvard University. The Organizing Committee is indebted to one of the Foundations for financial support.

The following sessions are planned: September 5 (A.M.), Progress in Quantitative Genetics—Leading paper: "A Quantitative Theory of Genetic Recombination," R. A. Fisher, University of Cambridge; (P.M.), Recent Biometric Developments in Certain European Institutes—Informal reports by foreign delegates; September 6 (A.M.), International Cooperation in Biometrics; (P.M.), Quantitative Growth—Leading paper: "The Basic Laws of Growth," G. Teissier, Centre National de la Recherche Scientifique, Paris. The sessions are open to all who may be interested.

Living accommodations for many of those attending the conference have been made available by the Marine Biological Laboratory, and information on other accommodations in and near Woods Hole is being compiled. Since the summer schedule will no longer be effective, the New Haven train 24, leaving Grand Central Terminal at 4:00 P.M. (D.S.T.) on Thursday, September 4, will be met at Providence by chartered buses. These will leave the Station in Providence at 8:00 P. M. (D.S.T.) directly for Woods Hole. Through train service from Woods Hole to New York and Boston is available on Sunday morning and late afternoon, September 7. Those interested in attending the conference may apply for information on living accommodations and for space on the chartered bus to C. I. Bliss, Box 1106, New Haven 4, Connecticut.

Recent Deaths

Homer H. Plagge, 53, research professor of pomology, Iowa State College Agricultural Experiment Station, died June 5 of a heart attack while attending a conference on the campus.

H. W. Richey, 57, professor of horticulture, Iowa State College, died June 16 after a year's illness. Prof. Richey had been on the Iowa staff for 27 years.

Arthur Gideon Cole, 48, assistant professor of biological chemistry, University of Illinois, College of Medicine, died in Chicago on July 14. Dr. Cole had been a member of the staff in biological chemistry since 1924.

Clarence M. Weed, 82, retired president of Lowell State Teachers College, Lowell, Massachusetts, and well-known entomologist, died July 18 at his summer home in Plymouth, New Hampshire.

Francis J. Seery, 73, professor emeritus of hydraulic engineering, Cornell University, died on July 27 in Dover, Delaware, after a long illness.

The Connecticut Agricultural Experiment Station is currently distributing its new 64-page Annual Report, entitled "Science Works for Agriculture." The booklet attempts to show how research aids the farmer in each of the 8 phases of the Station's work: insect control, disease control, plant breeding, soil science, forestry, tobacco research, analytical chemistry, and biochemistry. The report is available free of charge to any resident of Connecticut upon request to the Connecticut Agricultural Experiment Station, New Haven.

The Conference on Premedical Education sponsored by Alpha Epsilon Delta, national honorary premedical fraternity, at the University of Louisville, February 21–22, was attended by representatives of 9 medical schools and about 70 undergraduate colleges and universities situated in Ohio, Indiana, Michigan, Illinois, and Kentucky, according to the report of Hugh E. Setterfield, national president of the fraternity. The two main sessions dealt with (1) problems in the natural sciences and (2) problems in the social sciences and humanities in relationship to premedical and medical education. John L. Caughey, Jr., assistant dean, School of Medicine, Western Reserve University, keynoted the first session; Paul F. Bloomhardt, professor of biography, Wittenberg College, the second; and the dinner meeting was addressed by Father Hunter Guthrie, dean, Graduate School, Georgetown University, on "The Need for Liberal Arts in a Premedical Education."

From the discussions it was evident that there was much interest and concern regarding the methods, content, and direction of current premedical and medical education. There was almost unanimous agreement that heretofore there has been a tendency to overemphasize the science content of premedical education, with consequent neglect of the social sciences and humanities. It was felt that the medical profession should become more aware of, and responsible for, present social ills. Those in attendance agreed that students preparing for the study of medicine should be thoroughly grounded in the fundamentals of physics, chemistry, and biology required for admission to medical school, but no more; and that such students should take more courses in the social sciences and humanities. The Conference recommended that students take the full four-year liberal arts course leading to a Bachelor's degree, about 50 semester hours being devoted to the natural sciences, and the remaining 70–80 hours to the social sciences and humanities. According to Dr. Setterfield's report, many felt that foreign language requirements for admission to medicine should be dropped, although languages should be retained in the college degree programs.

A complete report, including the papers and discussion, appears in the May issue of *The Scalpel*, obtainable at Alpha Epsilon Delta, 3853 Lakewood, Detroit 15, Michigan.

A proposal to set up an International Mathematics Union was well supported by a meeting of mathematicians from Europe and America at UNESCO house, Paris, June 24, under the auspices of the Mathematical Society of France. The next step in the creation of the Union will be taken in October, when the Mathematical Society of France will call a meeting of representatives of various national mathematical bodies which will be empowered to set up the international organization, should they desire to do so.

Two new international scientific journals have recently been announced by the Elsevier Publishing Company, New York City. *Analytica Chimica Acta*, a monthly publication devoted to all branches of analytical chemistry, is under the editorship of Paul E. Wenger, 8 rue St. Victor, Geneva, Switzerland. The annual subscription is $9.50 (postage free). The other journal, *Biochimica et Biophysica Acta*, to be published 6–8 times annually by Elsevier and Interscience Publishers jointly, is under the supervision of an Editorial Board consisting of W. T. Astbury (Leeds), A. Braunstein (Moscow), C. F. Cori (St. Louis, Missouri), Cl. Fromageot (Lyons), K. Linderstrøm-Lang (Copenhagen), H. G. K. Westenbrink (Utrecht), and R. W. G. Wyckoff (Bethesda, Maryland). The subscription price is $9.00 (postage free). Manuscripts submitted to both journals should be in English, French, or German. Brief summaries of the articles will appear in each of these languages. Subscriptions from the Western Hemisphere should be sent to the Elsevier Book Company, 215 Fourth Avenue, New York City 3; from all other countries to the Elsevier Publishing Company, 118 b, Spuistraat, Amsterdam C.

The German Hydrographic Institute, now functioning in Hamburg, is to have a new medium of publication for articles emanating from the Institute, according to a letter from J. N. Carruthers, Manor Fields, Putney, London. The new *German Hydrographic Journal*, which will cover material in the fields of coastal and open-sea surveying, nautical science, navigation, chronometry, terrestrial magnetism, ship's magnetism, nautical technics, tides, and physical and chemical oceanography, will, as far as the foregoing subjects are concerned, take the place of the former *Annalen der Hydrographie und maritimen Meteorologie*, published by the German Admiralty from 1873 to 1891 and thereafter by the Deutsche Seewarte up to 1944. As far as possible, each issue will contain articles on a variety of the above-named subjects as well as including notices on hydrographic institutions and related matters. Notices and reviews of publications of interest to the Institute will also appear, together with a current bibliography relating to the special fields of research enumerated. An ultimate aim is the gradual listing of all German and other relevant publications which have appeared since the autumn of 1939. The journal will appear under the supervision of G. Boehnecke, German director of the Institute, and will be edited by Arnold Schumacher.

New England sunspot observers and amateur astronomers met July 12 at the Milton Academy Observatory for a morning discussion period headed by A. E. Navez, director, Milton Observatory. The afternoon session, held at the Blue Hill Observatory, was in charge of Charles Brooks, director, who demonstrated some of the Harvard University meteorological equipment there. The work of this group is conducted as a special Solar Division of the American Association of Variable Star Observers. Observations from periodic observers, collated at Harvard University, form the basis for calculations of long-range magnetic disturbances vitally affecting world-wide communications systems.

The Virginia Junior Academy of Science and the 185 Science Clubs in Virginia high schools have recently received a contribution of $1,000 from the Newport News Shipbuilding and Dry Dock Company for the encouragement of scientific studies by talented secondary school students. Previously another $1,000 had been contributed by an industrial concern to defray the expenses of the Second Virginia Science Talent Search just terminated (*Science*, July 11, p. 34). All of the work connected with these youth projects of the Virginia Academy of Science is carried out by volunteer senior scientists. The funds contributed are used solely for awards to boys and girls who show marked aptitudes for scientific careers. This is one of the best examples in the country of working partnerships on a state level between business and education.

West Virginia University Agricultural Experiment Station recently announced in our columns the publication of a technical reference book by Burch H. Schneider, the title of which should have been *Feeds of the world, their digestibility and composition*, not *Weeds of the world*, etc.

Make Plans for—

American Pharmaceutical Association, August 24, Milwaukee, Wisconsin.

American Society of Mammalogists, August 24–27, Higgins Lake, Michigan.

American Institute of Electrical Engineers, Pacific General Meeting, August 26–29, San Diego, California.

American Psychological Association, September 9–13, Detroit, Michigan.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS *by Readers*

The article by E. Margoliash (*Science*, April 4, pp. 369–370) suggests the following comment:

Difficulties of obtaining sterile preparations from nonsterile treated raw tissue extracts have been the main hindrance to the study of the effect of these substances on wound healing in tissue cultures and in medicine. In his paper Margoliash recommends a "new method" of sterilization of the dry proteins. This method, involving the use of acetone or benzene, was originally designed long ago. It was described by both the undersigned and T. Astrup (*Acta Physiol. Scand.*, 1941, **3**, 54; *Pflüg. Arch. ges. Physiol.*, 1943, **247**, 34) and later adopted by J. Davidson and C. Waymouth (*Biochem. J.*, 1945, **39**, 188) in their work on nucleoproteins and cell multiplication.

Margoliash has failed to give due reference to the author of the method, in spite of the fact that the particular articles cited were sent to him long ago. (ALBERT FISCHER, *Biological Institute, Carlsberg Foundation, Copenhagen, Denmark.*)

The results of creatinine, hippurate, and inulin clearance estimations in rats have been reported recently by M. Friedman (*Amer. J. Physiol.*, 1947, **148**, 387), who concluded that these clearances "vary directly with the urine flow." This conclusion differs from that of Dicker and Heller (*J. Physiol.*, 1945, **103**, 449) in that no such correlation was observed in their experiments comprising 134 estimations of inulin clearances in rats. It would therefore seem of interest to comment on Friedman's technique and his results.

At variance with the technique of Dicker and Heller, Friedman anaesthetized his rats immediately before the beginning of the urine-collecting period. The anaesthetic is not specified, but he states that "the clearances were not influenced by the very brief duration of anaesthesia." No experimental evidence for this claim is given. However, judging from the disturbance of the water metabolism in rats anaesthetized with chloroform or ether (H. Heller and F. H. Smirk. *J. Physiol.*, 1932, 76, 292), and considering the results of clearance experiments on anaesthetized dogs (A. C. Corcoran and I. H. Page. *Amer. J. Physiol.*, 1943, **140**, 234; F. N. Craig, F. E. Visscher, and C. R. Houck. *Amer. J. Physiol.*, 1945, **143**, 108), it would seem hazardous to dismiss so lightly the possible effects of anaesthesia. But, even assuming that light anaesthesia did not interfere with the results of Friedman's clearance estimations on rats, it should be pointed out that his animals were disturbed further (a) by withdrawal of up to 1.75 cc. of blood from the tail immediately before the beginning of the urine-collecting period, (b) by a tourniquet placed on the stump of the tail and kept in position in the unanaesthetized animal, and (c) by handling (administration of water and injections) during the urine-collecting period. The adverse effects of these procedures on kidney function can be demonstrated from the author's own figures: Normal rats (given 5 cc. water/100 grams body weight) excrete about 3 cc./100 grams in two hours. In the case of Friedman's animals. 26 out of 101 excreted less than 1 cc./100 grams in two hours, and 31 less than 2 cc. in two hours, indicating that many of his rats suffered from a marked inhibition of diuresis. It was probably because of this poor urinary output in a majority of his animals that Friedman decided to extend his urine-collecting periods to two hours. A period of this length involves unnecessarily large changes of the plasma concentration of the test substance. Much shorter periods are therefore commonly used. Estimations of the plasma concentration of the test substance at the beginning and end of a two-hour period are unlikely to compensate for this disadvantage, especially when, as in Friedman's case, creatinine was given a second and third time *after* the initial blood sample was taken.

Taking the results of Friedman's experiments as a whole, it would seem that at very low ranges of urine flow, *i.e.* in animals suffering from inhibition of diuresis due probably to pain, anaesthesia, etc., variations of clearance with urine flow may occur. [The effects of increased secretion of the posterior pituitary hormones (S. E. Dicker and H. Heller, *J. Physiol.*, 1946, **104**, 353) and of adrenaline should be considered in this connection.] However, at higher rates of urine flow (1–2 cc./100 grams/hour) not only are Friedman's figures for inulin clearances similar to ours but it can also be shown that they bear no clear relation to the rate of diuresis. A statistical comparison between his figures at urine flows of 1–1.5 cc./100 grams/hour and those at 1.5–2.0 cc./100 grams/hour shows no significant difference (Fisher's $t = 1.399$, $P > 0.1$). It seems probable, therefore, that the relation between inulin clearance (= glomerular filtration rate) and rate of urine flow in the rat is similar to that in the dog, in which very low rates of flow are also accompanied by low inulin clearances but the rate of glomerular filtration is regarded as "essentially constant and unrelated to the rate of urine flow in the ordinary experimental range of the latter" (J. A. Shannon. *Amer. J. Physiol.*, 1936, **117**, 206; H. W. Smith. *The physiology of the kidney*. London: Oxford Univ. Press. P. 64). (S. E. DICKER and H. HELLER, *Department of Pharmacology, University of Bristol.*)

In presenting the case for a National Institute of Biology (*Science*, May 30, p. 559) Robert F. Griggs tabulates and classifies in great detail the array of divers organizations that make up the biology fraternity—from the Society of Agronomy to the Society of Zoologists. Yet nowhere in Dr. Griggs's paper is as much as a passing mention made of the teachers of biology in our secondary schools, a group organized locally, regionally, and nationally. These men and women are devoting their lives to the dissemination of biological knowledge and to the development of an appreciation of the role that biological knowledge can play in the lives of individuals and in society.

Among his concluding remarks Dr. Griggs states: "All biology must organize to lead the public in its thinking on biological matters." One wonders how far the public is going to be led if we leave out of consideration entirely our first line of contact with the public at its most formative stage. (ZACHARIAH SUBARSKY, *Department of Biology, The Bronx High School of Science.*)

TECHNICAL PAPERS

Effect of Certain Substances on the Prevention of Diabetogenic Action of Alloxan

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Archibald (*1*) described a method of estimation of alloxan by its reaction with o-phenylene diamine. Weinglass, Frame, and Williams (*6*) showed that when 3,4-diaminotoluene, o-phenylene diamine, and sodium bisulfite were injected intravenously in rabbits followed by the injection of alloxan, the hypoglycemic and diabetogenic actions of alloxan were prevented. While developing a sensitive test for the determination of a minute amount of alloxan it was shown (*2*) that alloxan reacted with 1 2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene, forming riboflavin. It was of interest to attempt to discover whether the same reaction, whereby the diabetogenic action of alloxan would be prevented, would take place *in vivo* in rabbits and rats. Action of nicotinic acid on the production of alloxan diabetes was also studied accidentally, and it was observed that it did prevent the diabetogenic action of alloxan in rabbits and rats. In order to explain the mechanism of action of nicotinic acid it was of interest to study the action of calcium pantothenate, glycine, benzoic acid, p-aminobenzoic acid, ascorbic acid, pyridoxine-hydrochloride, pyridine-dicarboxylic acid, and 2-phenyl quinoline-4-carboxylic acid in inhibiting the action of alloxan.

1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene. On the first day, a 10 per cent solution of this substance in a 200-mg./kg. dose was injected into the marginal ear vein of each of 6 rabbits which were fasted overnight and kept in separate metabolism cages for the collection of urine under toluene. The injection was immediately followed by one consisting of a 10 per cent solution of alloxan (100 mg./kg.), and the ear, along the course of the vein, was then stained yellow. Since none of the animals excreted sugar, these injections were repeated in the same doses on the next day, and blood was taken at intervals of 1 hour for 5 hours in 3 of the rabbits. Fasting blood was again taken from all 6 rabbits on the third morning. Blood sugar was determined by the method of Hagedorn and Jensen (*4*). Blood sugar changes in 3 of the rabbits are given in Table 1. All 6 showed normal blood sugar on the third day. Six control rabbits, receiving alloxan (100 mg./kg.) for only a day, did develop diabetes and excreted sugar in the urine. A dose of 400 mg./kg. of 1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene was found to be toxic in rabbits.

Intraperitoneal injections of 1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene (400 mg./kg.) and alloxan (200 mg./kg.) were made, one after another, in 6 rats averaging 100 grams in weight. No hyperglycemia or glycosuria was observed. When injected with alloxan only, all developed diabetes.

Nicotinic acid. Nicotinic acid and alloxan in doses of 100 grams/kg. were injected intravenously, one after another, in 5 rabbits. None of the rabbits excreted sugar in urine on the second day. After repeating the injections as before, samples of blood were taken at intervals of 1 hour, as mentioned previously. Blood sugar values are shown in Table 1. When both nicotinic acid and alloxan were injected in a dose of 200 mg./kg. in 3 rabbits, 2 of the animals developed hypoglycemic convulsions and died, while the third developed neither hypoglycemia nor diabetes.

TABLE 1

Substances used	Rabbit No.	Weight of rabbit (grams)	Fasting blood sugar (mg. %)	Blood sugar after intravenous injections of different substances and alloxan (mg. %)					
				1 hr.	2 hr.	3 hr.	4 hr.	5 hr.	24 hr.
1,2-Dimethyl-4-amino-5-(d-1′-ribitylamino)-benzene	1	1,080	90	152	111	111	112	141	90
	2	1,720	98	195	204	208	146	92	92
	3	1,370	114	—	—	—	—	205	110
Nicotinic acid	1	1,750	100	—	—	—	—	—	95
	2	1,440	96	300	313	275	91	91	90
	3	1,400	121	156	196	128	—	—	100
	4	1,157	94	76	85	94	62	78	85
	5	1,300	107	117	149	—	—	—	100
Calcium pantothenate	1	1,450	105	268	315	313	284	254	385
	2	1,730	75	213	51	Convulsion and death			

In experiments with 6 rats with an average weight of 100 grams, intraperitoneal injections of nicotinic acid and alloxan (100 grams/kg.) for 3 consecutive days produced neither hyperglycemia nor glycosuria. All the rats, however, developed diabetes when injected with alloxan only on the fourth day.

Pantothenic acid. Calcium pantothenate (400 mg./kg.) and alloxan (200 mg./kg.) were injected intravenously in 2 rabbits for 1 day only, and blood samples were taken as before. Results are given in Table 1.

As the injections of calcium pantothenate together with alloxan showed constant hyperglycemia in 1 rabbit, the effects of intravenous injections of 100 mg. of calcium pantothenate alone on the blood sugar of normal and alloxan diabetic rabbits were studied. Results are given in Table 2.

Glycine. Glycine (60 mg./kg.) and alloxan (100 mg./kg.) were injected as before for 1 day only in 4 rabbits. No hypoglycemia was observed, but all the animals excreted sugar in urine and showed hyperglycemia on the succeeding days.

Benzoic acid, p-aminobenzoic acid, and ascorbic acid. Benzoic acid and p-aminobenzoic acid were dissolved in water with the addition of normal sodium hydroxide, and a watery solution of ascorbic acid was brought to pH 3.5 with sodium hydroxide. Separate injections of these substances, in doses of 100 mg./kg., followed by injection of alloxan (100 mg./kg.), were made in 3 groups of rabbits, each containing 2 rabbits, as before. Since none excreted sugar on the following day, the injections were repeated. Animals showed persistent hyperglycemia and glycosuria from the third day.

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[1] The author expresses his gratitude to F. M. Fruter, of Hoffmann-La Roche, Inc., for the supply of alloxan, 1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene, nicotinic acid, calcium pantothenate, and pyridoxine hydrochloride; to R. T. Major, of Merck & Co., Inc., for p-aminobenzoic acid; and to N. C. Guha, of East India Pharmaceutical Works, Calcutta, for pyridine-dicarboxylic acid and 2-phenylquinoline-4-carboxylic acid.

Pyridoxine hydrochloride. Pyridoxine hydrochloride (150 mg./kg.) and alloxan (100 mg./kg.) were injected in 3 rabbits and the injections repeated on the second day. All the animals developed glycosuria and hyperglycemia.

Pyridine-dicarboxylic acid and 2-phenylquinoline-4-carboxylic acid. These substances, in doses of 125 and 200 mg./kg., respectively, were separately injected in 2 groups of rabbits, each containing 3 animals. The injections were immediately followed by the injection of alloxan (100 mg./kg.). Since the urines of all the animals were sugar free on the next day, the injections in the same doses were repeated. None developed either hyperglycemia or glycosuria.

TABLE 2

Rabbits	Rabbit No.	Weight of rabbit (grams)	Fasting blood sugar (mg. %)	Blood sugar after intravenous injection of calcium pantothenate (mg. %)			
				¾ hr.	1½ hr.	2¼ hr.	3 hr.
Normal	1	1,360	101	119	115	121	124
	2	1,380	89	131	—	151	122
	3	1,710	101	126	105	100	86
Alloxan-diabetic	1	1,800	516	562	535	598	593
	2	2,200	410	426	464	464	521
	3	1,175	264	300	400	—	441

The results are summarized in Table 3.

Although 1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene prevented the diabetogenic action of alloxan in rabbits and rats, it could not prevent the initial hyperglycemia generally observed after intravenous injection of alloxan in rabbits. In view of the yellow coloration of the veins through which the substances were injected, it might be suggested that the same condensation as studied *in vitro* (*2*) also took place *in vivo* and alloxan thereby removed from the field of its action. As the condensation of 1,2-dimethyl-4-amino-5(d-1′-ribitylamino)-benzene and alloxan might yield riboflavin *in vivo*, like the condensation studied *in vitro*, the reverse reaction might also be possible in the system. Riboflavin under some circumstances may break up and liberate alloxan in the system, which may play some role in the etiology of diabetes mellitus.

Nicotinic acid in most of the rabbits studied could not prevent the initial hyperglycemia which might be due to the secretion of adrenalin as a consequence of the injections. None of the rabbits, however, developed hypoglycemia or persistent hyperglycemia and glycosuria. Nicotinic acid also inhibited the diabetogenic action of alloxan in rats. When nicotinic acid and alloxan were injected in 200-mg./kg. doses, the hypoglycemic and diabetogenic actions of alloxan were not prevented in 2 of the rabbits studied. The doses of the substances were roughly equimolecular, and it might be possible that in the system, when the dose of alloxan was high, all the alloxan could not combine with nicotinic acid, and hence its diabetogenic action could not be prevented.

Calcium pantothenate could not prevent the diabetogenic action of alloxan, but in 1 rabbit there was persistent hyperglycemia just after the injections of calcium pantothenate and alloxan. The effect of intravenous injection of calcium pantothenate alone on the blood sugar of normal and diabetic rabbits showed that calcium pantothenate raised the blood sugar slightly in normal rabbits and considerably in alloxan-diabetic rabbits. The claim of Vecchio (*5*) that pantothenic acid considerably reduces the blood sugar level in children could not be confirmed in our experiments with rabbits.

Glycine, benzoic acid, p-aminobenzoic acid, and ascorbic acid also could not prevent the development of alloxan diabetes. These observations indicate that the carboxyl group of nicotinic acid is not responsible for the action. Pyridoxine hydrochloride also could not prevent the action of alloxan, which indicates that the pyridine ring is likewise not active. Pyridine-dicarboxylic acid and 2-phenylquinoline-4-carboxylic acid, which, like nicotinic acid, contain both the carboxyl group and the pyridine ring, could inhibit the diabetogenic action of alloxan. It seems, therefore, that the entire nicotinic acid molecule combines with alloxan and prevents its action. It has been suggested by Dunn, *et al.* (*3*)

TABLE 3

Substances used	No. animals used	Dose of substance (mg.)/kg./day	Dose of alloxan (mg.)/kg./day	No. of animals which developed persistent hyperglycemia and glycosuria
1,2-Dimethyl-4-amino-5(d-1′-ribitylamino)-benzene	Rabbits 6	200 2 days	100 2 days	0
	Rats 6	400 1 day	200 1 day	0
Nicotinic acid	Rabbits 5	100 2 days	100 2 days	0
	Rats 6	100 3 days	100 3 days	0
Calcium pantothenate	Rabbits 2	400 1 day	200 1 day	1 (another died)
Glycine	Rabbits 4	60 1 day	100 1 day	4
Benzoic acid	Rabbits 2	100 2 days	100 2 days	2
p-Aminobenzoic acid	Rabbits 2	100 2 days	100 2 days	2
Ascorbic acid	Rabbits 2	100 2 days	100 2 days	2
Pyridoxine hydrochloride	Rabbits 3	150 2 days	100 2 days	3
Pyridine-dicarboxylic acid	Rabbits 3	125 2 days	100 2 days	0
2-Phenylquinoline-4-carboxylic acid	Rabbits 3	200 2 days	100 2 days	0

that possible defects in the metabolism of purines or of alloxan in man may play some role in the etiology of diabetes. If the diet contains sufficient nicotinic acid, it might combine with alloxan so formed and thereby prevent its action. Nicotinic acid thus might play some part in the prevention of diabetes.

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Transmission of the Bunchy Top Disease of Papaya (*Carica papaya* L.) by the Leaf Hopper *Empoasca papayae* Oman

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In 1946 Adsuar (*1*) reported the successful transmission of papaya bunchy top by a leaf hopper of the genus *Empoasca*, presumably identical with the one previously used experimentally by Jensen (*2*) in 1938. In their experiments, Adsuar and Jensen used as vectors the leaf hoppers collected on diseased papaya plants in the field but did not identify them specifically. Specimens collected on papaya in Puerto Rico were described by P. W. Oman (*3*) as *Empoasca papayae*, but as more than one species of *Empoasca* may occur on papaya, the specific identity of the vector used by Adsuar and Jensen can only be presumed.

Specific identification of the females of the genus *Empoasca* being practically impossible, the senior author followed a simple method of elimination which permits the use of males only as vectors. Specimens of both sexes collected from diseased papaya trees were exposed to the vapors of ether to render them quiet long enough to permit the separation of the males from the females under the binocular. The desired number of males were released inside cellophane casings inserted on the upper part of the stem and tender leaves of healthy papaya plants.

The identification of the 169 male leaf hoppers recovered dead two or three days later, when the casings were removed, was confirmed by P. W. Oman, of the U. S. Department of Agriculture, as his *Empoasca papayae*.

Out of 30 healthy papaya plants, on each of which from 5 to 10 males were isolated, 9 plants developed the symptoms of bunchy top in about a month and a half. Thirty similar check plants, kept with the others in a greenhouse from which leaf hoppers were excluded, remained healthy. This experiment conclusively demonstrates that *Empoasca papayae* Oman is a vector of the bunchy top disease of papaya.

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Fluorescein as an Agent in the Differentiation of Normal and Malignant Tissues[1]

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For many years investigators have noted and described the differential appearance of various tissues under ultraviolet light. In 1934, Danckwortt (*1*) wrote an extensive monograph encompassing the entire subject.

Several authors have reported the use of ultraviolet light as an aid in distinguishing neoplastic tissue. Some have even claimed a specific fluorescence for certain tumors. This, however, has never been consistently substantiated.

Herly (*2*), in 1944, reported that differences in the macroscopic appearance of benign and malignant tumors of the breast were enhanced when viewed under ultraviolet light. Using this technique, in a series of 200 breast tumors suspected of malignancy only one error in diagnosis was acknowledged.

Since October 1946, sodium fluorescein has been injected into patients subjected to laparotomy for gastric carcinoma, with the hope that it might accentuate the differences in appearance of normal and malignant tissues as revealed under ultraviolet light. Initially, 5 cc. of 20 per cent sodium fluorescein was injected intravenously after the viscera were exposed, and then inspected with an ultraviolet lamp emitting rays at about 3,600°. In these first cases no difference in fluorescence of normal and tumor tissues was noted. Next, the dye was injected at various times prior to the operation. It became evident that, when the interval between injection and examination was between 3 and 8 hours, a difference between normal and malignant tissues could be observed. Carcinomatous implants of tumor tissue on the peritoneal surfaces were readily seen. These fluoresced with a vivid yellow color. When, however, the tumor tissue was situated more than a few millimeters below the surface, no fluorescence was observed. This might be related to the fact that ultraviolet light can penetrate only a few millimeters of tissue.

To date, 46 neoplasms have been examined with this tech-

TABLE 1

OBSERVED CORRELATION BETWEEN FLUORESCENCE OF TUMOR OR TUMOR FRAGMENTS AND ULTIMATE HISTOLOGICAL DIAGNOSIS

Site of tumor	Total cases	Correlation*		
		Good	Poor	Failure
Gastrointestinal tract	17	11	3	3
Brain and spinal cord	12	11	1	0
Miscellaneous	17	9	2	6
Total	46	31	6	9

* Good indicates high grade of fluorescence with verified microscopic diagnosis; poor, only slight fluorescence; and failure, that the tumor or tumor fragments did not fluoresce.

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[1] These researches were supported by the Malignant Disease Fund for Research.

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nique. A histological diagnosis of a malignant neoplasm was made in each instance among the tabulated cases. The observation of fluorescence in the tumor was correlated with the ultimate diagnosis established by microscopic examination of the tumor (see Table 1). The majority of the 9 failures have occurred in attempts to fluoresce large, bulky, abdominal tumors. Carcinomata of the colon, stomach, and breast were found to be less likely to fluoresce. This might be related to the factors of dosage or the lack of a sufficient time interval between injection of the dye and examination. It has also been found that areas of edema and cyst formation will retain the dye for many hours. This is a source of confusion in attempts to fluoresce abdominal masses. In addition, it should be noted that necrotic tissue will not fluoresce, since dead cells are not stained by the dye.

The most consistent results have been obtained in the examination of brain tumors. Twelve cases suspected of having an intracranial neoplasm were examined with the fluorescein technique (Table 1). In subcortical lesions this test has been of particular value. Tumor tissue secured from suspected areas by aspiration needle biopsies was readily recognized by the exaggerated fluorescence observed under ultraviolet light. Both the glioma and meningioma groups of brain tumors have been recognized correctly as tumor tissue by this method. In each case, the fluorescent areas have been subsequently proven neoplastic by standard methods of pathological examination.

An attempt has been made to quantitate by fluorometric methods the amount of dye present in both tumor and normal tissues after varying time intervals.

In additional studies, employing iodine substitution products of fluorescein, an increased visualization of certain mouse tumors by X-ray was noted. The possibility of using radioactive iodine in these substituted dyes has been considered.

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IN THE LABORATORY

Methods for Culturing Termites

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Progress in the study of the determination of castes in termites is dependent upon the development of satisfactory methods of culturing groups taken from both large colonies and incipient primary colonies (*2*).

Maintenance of groups of termites in the laboratory under conditions sufficiently standardized to permit a comparison of results necessitates: (1) a satisfactory source of food material; (2) the continued presence of moisture but avoidance of excessive moisture, especially free moisture; (3) visibility for observation without taking down the cultures; and (4) avoidance of conditions conducive to extensive development of microorganisms.

A method employing agar has been in use by the senior author for several years (*3*). The junior author has had much to do with the recent use and development of this method.

The standard procedure is as follows: A quantity of altered Monterey pine sawdust is first screened to remove very coarse wood chunks, bark, etc. and then sifted to remove fine, dust-like particles. To 2.8 grams of this sawdust, which is placed in the 1-ounce jar commonly used, is added 9 cc. of 3 per cent agar at a temperature low enough to prevent extensive absorption of agar by the particles of wood, yet high enough to allow complete mixing with the sawdust. Quantities are altered correspondingly for larger or smaller containers. When the agar is thoroughly mixed with the sawdust, the whole mass is pressed down firmly and leveled with the fingers. When the sawdust-agar mass has cooled, with the lid off, 4 or 5 cc. of 4.5 per cent agar is added just hot enough to pour (it is desirable to avoid large bubbles in the cap). Following solidification of the agar cap a hole is punched to the bottom along the glass through cap and agar-sawdust mass. A cork border is convenient for this purpose, the size depending upon the size of the species to be used and of the group. For small species a hole punched with a wire rod is sufficient. It is important to make this hole along the glass in order to facilitate observations.

The termites, which are placed on the agar surface, will usually enter the hole at once and begin working in the sawdust-agar mass, also usually sealing up the hole and thus conserving the moisture.

To prevent the excessive development of microorganisms, the jars should be thoroughly cleaned and autoclaved or boiled, and the termites should be carefully selected and handled as gently as possible. All inactive or injured ones should be removed and exposure to the air reduced to a minimum. If some die on the agar surface, they should also be removed. For methods of handling termites, see Light and Illg (*3*).

The size of the container and the amount of culture medium must be regulated to suit the number of termites to be supported. Small groups of termites cannot effectively control excessive development of microorganisms if a large quantity of culture medium is isolated from the termites. Free moisture occurs most commonly if the jar is closed before the agar has cooled.

In the sawdust-agar mass the termites work largely against the glass, making it possible to observe changes in individuals or the group. The agar in the mass and the cap serves to hold water; the cap, prevents escape of moisture from below and seals the whole to the jar. Extensive work by the termites in the mass often breaks it loose from the walls of the container unless it is held by the cap.

Altered sawdust is indicated theoretically by the findings of Roessler (*4*) and Hendee (*1*) that termites are dependent upon fungus for certain food elements. Cultures using sawdust from sound wood have proven uniformly unsuccessful. The choice of Monterey pine was one of convenience, since most of the termites cultured in earlier experiments were from logs of this species.

Many modifications of this procedure have been tried using thinner or heavier agar, different sawdusts, and combinations of soil and sawdust in layers, and using various fungicides in an attempt to prevent excessive growth of microorganisms. One modification involving the replacement of the agar cap with a layer of paraffin was unsuccessful in general because it caused early drying out. There seems some reason to believe that it may prove useful in culturing dry-wood termites. Further information regarding the standard method, its modifications, and the results obtained by it will appear elsewhere.

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An Improved Funnel Design

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A useful improvement on funnels for transferring liquids is obtained by cutting off most of the stem of a pyrex funnel and sealing on a standard-taper, ground-glass joint. Since no reference to such design has been seen in the literature, it is believed worthy of description.

The advantages of using such a funnel are several: A stable funnel-bottle combination is achieved in which the funnel does not tip or move when used for filling flasks and bottles. No funnel stem is immersed in the liquid. If the bottle has been overfilled, the excess liquid, instead of overflowing from the bottle as with the usual funnel, merely fills the funnel. Liquid is not wasted and, when permissible, can be poured back into the original container. The funnel does not have to be raised to allow air to escape from the bottle, the diameter of the joint being large enough to let the air pass up through the center while the liquid passes down the wall. The result is a funnel that permits much faster flow than any yet used.

The 65-mm. and 100-mm. pyrex funnels sealed to Ŧ 24/40 ground joints have proved most satisfactory for average use. The ground joint is cut off about ½ inch above the ground portion, and the funnel stem is removed; the funnel is cut high enough to allow easy mating with the joint. The two pieces are heated in a large, gas-oxygen flame until they are both quite soft; they are then joined, using slight pressure. Although no attempt is made to "blow" the joint, the seal should be complete and without pinholes. Careful annealing will remove strains, and the resulting joint is strong enough for most purposes.

Use of Radioactive Iodine as a Tracer in the Study of the Physiology of Teeth

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Although *in vitro* and *in vivo* dye studies (*2*) have proved valuable in research in dental physiology, such studies have limited applicability. Neither the surgical introduction of complex molecular dyes to teeth *in vivo* (*8*) nor the use of extracted teeth with accompanying permeability changes (*4*) provides an adequate demonstration of normal distribution of tissue fluid solutes in teeth.

The use of radioautography with radioactive iodine is presented as a method which clearly indicates the distribution of tissue fluid solutes in teeth under normal environmental conditions. Radioactive isotopes have been used in dental research since 1935 (*5*), but the results to date have been obtained with substances metabolized by teeth. While the need for studying metabolic processes is evident, a basic understanding of the pattern of distribution of tissue fluid solutes through the tooth tissues is fundamental.

Iodine was chosen as a suitable tool to trace the distribution of tissue fluid solutes in teeth because (1) it is highly soluble in tissue fluid (*1*); (2) it has not been demonstrated with microchemical or spectroscopic analysis to be normally present in the enamel, dentine, or cementum; and (3) it has a readily available and easily utilized radioactive isotope.

To obtain a histologic correlation of the location of radioactive iodine with the microscopic anatomy of the tooth, radioautography was utilized. At best, other methods indicate concentration of the material in a general area (*10*), whereas with radioautography specific distribution may be studied.

I^{131} in the form of NaI in physiologic saline solution was injected intraperitoneally into four cats and two rats. Approximately 0.5 millicurie/kg. of body weight was used. After 12 hours a blood sample was drawn, the animal put to death with ether, and the teeth removed intact. The blood sample was taken to establish the concentration of radioactive iodine in the blood at the time of sacrifice. Median longitudinal planoparallel sections of the teeth were made by grinding under oil on abrasive wheels to the thickness of 100–150 μ. The sections, after being buffed clean, dried, and weighed, were temporarily mounted on glass slides with Scotch tape in order to present one completely uncovered surface, and the activity determined by means of a Geiger counter. Assuming a uniform distribution of radioactive iodine and a negligible self-absorption of radiation, an estimate of the necessary exposure time was obtained, based on activity per unit area of section. Although this is not a quantitative method, it yielded highly satisfactory results.

In a darkroom the sections were placed directly in contact with the emulsion of Ansco No-Screen X-ray film and stored in cassettes and at the end of the calculated exposure time were removed from the film, which was developed under controlled conditions. The sections were then permanently mounted.

During the development of the technique Kodak medium lantern-slide plates, Ansco Triple-S Panchromatic film, and Kodachrome film for artificial light were also tried. A separate

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[1] Fellowship in Dentistry, Alice Goldschmidt Sachs Fund.

Geiger counter calibration must be made for each type of film used. The decision to use the No-Screen X-ray film was based on its high speed and relatively good contrast, with the realization that the large grain size might be a limiting factor in later work. When grain size is an important consideration, the medium lantern-slide plates are superior, but they require about triple the exposure time.

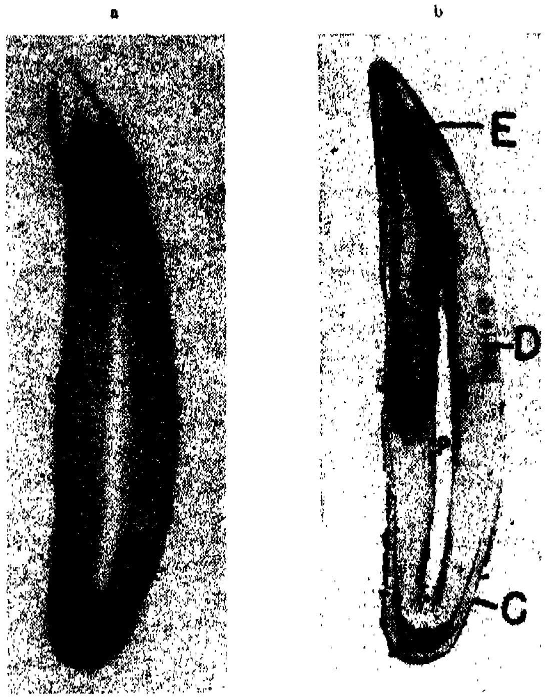

FIG. 1. (a) Radioautograph of a ground section of a canine tooth of an adult cat. (Artifact: scratch on emulsion at insical edge.) (b) Photomicrograph of the ground section from which the radioautograph was made. (C, cementum; D, dentine; E, enamel; P, pulp.)

Fig. 1a is a radioautograph of a cat canine, the outlines of which can be clearly discerned over the background. Irregularities in the background are due to damages in the emulsion caused by the Scotch tape mounting. Fig. 1b is a photomicrograph (same magnification) of the ground section from which the radioautograph was made. Note that radioactive iodine is present in the enamel, dentine, and cementum. In all figures the pulpal area is clear because the pulp was lost in grinding. In the dentine there is an even density except for an irregular distribution of radioactive iodine in the coronal and apical regions with bare areas proximal to the enamel and cementum. Radioactive iodine is seen to be distributed throughout the cementum with relatively high density in the outer portions and decreasing density near the dentine.

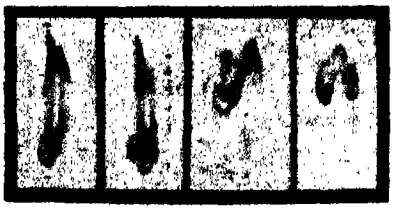

FIG. 2. Radioautographs of ground sections of teeth of another adult cat.

Fig. 2 illustrates radioautographs made from ground sections of teeth of another adult cat. These are presented to emphasize the variation in distribution of radioactive iodine under uncontrolled conditions.

Correlation between radioautographs and histologic structure depends upon detailed study of the ground sections as well as good radioautographs. This detailed study may be enhanced by utilizing staining techniques to bring out the histologic structure in the ground section.

To get the maximum information from the study of a radioautograph it is necessary to compare identically corresponding points in the autograph and the original section. This condition can best be approximated with the present technique by manually superimposing a negative of a photomicrograph of the section on one of the radioautograph. Evans (*7*) has recently developed a method of obtaining an automatically superimposed section and radioautograph for soft tissues. An adaption of this method for calcified tissue sections may be possible and would be highly desirable.

In view of the high solubility of iodides in tissue fluids and the evidence that some form of tissue fluid does exist in teeth (*4*), the radioactive iodine will appear in those portions of the tooth to which fluid is transported from the blood stream, by whatever mechanism. The radioautographs above show radioactive iodine uptake by the teeth, giving further indication that a dynamic fluid medium exists in the calcified structures.

The distinction between a metabolized substance and one such as iodine may be indicated by the comparison of our radioautographs with phosphorus radioautographs such as those published by Erbacher and Wannenmacher and Berggren (*6*). The best ones seen by the authors were done by Bevelander and Amler (*3*), but these have not been published. The radioautographs show that the radioactive phosphorus concentration is highest in young teeth and is higher in those parts of adult teeth that have not matured. It can be readily seen from the radioactive iodine autographs that this distribution is not true of iodine.

At present the size of the dose of radioactive iodine necessary to obtain a satisfactory radioautograph has limited dental studies in humans to individuals receiving large doses for treatment of thyroid disorders (*9*). An attempt is being made to refine the technique sufficiently to obtain autographs from the administration of safe tracer doses to normal individuals.

The results obtained demonstrate the efficacy of the use of radioautography with radioactive iodine as a method for studying the physiology of the fluid in teeth in communication with the systemic circulation.

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Book Reviews

Applied anatomy of the head and neck: for students and practitioners of dentistry. (2nd ed.) Harry H. Shapiro. Philadelphia-London-Montreal: J. B. Lippincott, 1947. Pp. xvi + 303. (Illustrated.) $10.00.

As its subtitle indicates, this book is concerned mostly with the application of the anatomy of the face, mouth, and jaws to dentistry and oral surgery. Other features of the anatomy of the head are also treated from this point of view. The neck, except for surface anatomy, is not completely covered.

The opening chapter presents surface and topographical anatomy which is well correlated with the later treatment of roentgenographic interpretation and the skull with its anthropometry.

Other chapters are devoted to: development (written by Bernice L. Maclean, the author's wife), the teeth and dental arches, the nose and paranasal sinuses, the temperomandibular joint, musculature, glands, neuroanatomic considerations, and blood vessels and lymphatics. Finally, oral infections, maxillofacial war injuries, and the edentulous mouth are considered. The temperomandibular joint is particularly well handled, and its mechanics are given clearly and accurately—a rather rare accomplishment. The peripheral nerves are presented with special emphasis on problems of anaesthesia. The description of the lymphatics is hardly adequate and constitutes a defect in the otherwise thorough treatment of oral infections and their possibilities for spread.

The general surgeon, the neurologist, and the ophthalmologist will not find this book particularly well suited to their needs. The anatomist may be a little troubled over a few inconsistencies in terminology and the treatment of occasional controversial issues. The book is, however, written from a fundamental point of view and constantly emphasizes the necessity for accurate basic knowledge. It presents clearly a great deal of well-illustrated and well-documented information and to the group for which it was written it should prove a highly valuable work.

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A survey of antimalarial drugs, 1941–1945. Frederick Y. Wiselogle. (Ed.) Ann Arbor, Mich.: J. W. Edwards, 1946. Vol. I: Pp. xi + 536; Vol. II, Pt. 1: Pp. 987; Vol. II, Pt. 2: Pp. 988–1921. $30.00.

During the war the Office of Scientific Research and Development, on recommendation by the Committee on Medical Research, sponsored and supported a vast program of research in malaria chemotherapy (*Science*, January 4, 1946, pp. 8–9). Dr. Wiselogle headed the Survey office which was established, under a contract with The Johns Hopkins University, to collect, systematize, and disseminate the findings of research workers in this field. The data collected are summarized in this monograph.

Volume I comprises six disquisitive chapters: I, "History of the Co-operative Wartime Program"; II, "Pharmacological Investigations of Potential Antimalarial Drugs"; III, "Chemical Series of Potential Interest"; IV, "Rationale Underlying the Clinical Evaluation of Antimalarial Drugs"; V, "Summary of Data on the Drugs Tested in Man"; and VI, "Descriptions of the Various Testing Procedures."

Volume II is a tabulation of the results obtained in tests of approximately 12,400 drugs in roughly 50,000 groups of laboratory animals. Actually, more than 13,000 different substances were screened, but some were omitted from the monograph because releases could not be obtained from their suppliers. Except for about 600 miscellaneous drugs, each entry includes, in addition to the test results and Survey Number, the structural formula (probable) on the basis of which the drug was classified in the Survey system, the corresponding molecular formula, and the name in accordance with the system of *Chemical Abstracts*. This volume also contains the three indexes to the monograph, arranged by subject, molecular formula, and Survey Number (SN number), respectively.

Methods of synthesis, biochemical and parasitological studies, and certain intensive pharmacological and clinical studies, which did not lend themselves to the system of presentation of the monograph, have been left for publication by the individual investigators.

"The monograph was prepared with two main objectives constantly in mind: (1) to expedite the search for still better antimalarial drugs and (2) to serve as an established pattern for systematic chemotherapeutic studies of other infections." In addition, it presents organic chemists with a welcome pattern for naming compounds, drawing their structures, and classifying them functionally.

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Scientific Book Register

Andrews, Henry N., Jr. *Ancient plants and the world they lived in.* Ithaca, N. Y.: Comstock, 1947. Pp. ix + 279. (Illustrated.)

Gottlieb, Bernhard. *Dental caries: its etiology, pathology, clinical aspects, and prophylaxis.* Philadelphia: Lea & Febiger, 1947. Pp. 262. (Illustrated.) $10.00.

Hull, Thomas G. *Diseases transmitted from animals to man.* (3rd ed.) Springfield, Ill.: Charles C. Thomas, 1947. Pp. xvii + 571. (Illustrated.) $10.50.

Levine, S. Z., *et al.* (Eds.) *Advances in pediatrics.* (Vol. II.) New York-London: Interscience, 1947. Pp. x + 409. (Illustrated.) $6.75.

Riddle, Oscar. *Studies on carbohydrate and fat metabolism, with especial reference to the pigeon.* (Publ. 569.) Washington, D. C.: Carnegie Institution of Washington, 1947. Pp. v + 128. $1.85, paper; $2.25, cloth.

Roth, H. Pregl's *Quantitative organische mikroanalyse.* Vienna, Austria: Springer-Verlag, 1947. Pp. xi + 317. (Illustrated.) $7.40.

A Survey of the Sciences

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THE TITLE WHICH I HAVE CHOSEN FOR this address is a presumptuous one. In a brief half hour we must attempt a survey of the sciences, give some idea of their different natures, tell something about their present doings, and throw a look to their future. To find our way through this difficult task, we shall need some guiding principle. For this purpose let us regard the different sciences as arranged in a hierarchy, on a sort of ladder, in the order of their abstract character. This is a useful principle of arrangement for which we have long been indebted to the French philosopher, Auguste Comte, along with some other good things and some pompous bosh.

At the base of the ladder we place mathematics, the discipline which carries furthest the process of abstraction, by selecting—abstracting out—for study from the real world only the simplest and most general concepts such as those of order, number, and dimensionality. By taking into consideration further concepts abstracted out from the real world, such as those of matter, energy, and electricity, we come to the science of physics. By including the concept of different kinds of substance and of chemical change from one kind to another, we arrive at chemistry. By adding the concepts of a special kind of matter called living and of a special kind of behavior called mental, we come to biology and psychology. And, by including in our study more and more of the complexities of the actual world around us, we could pass on to social psychology, economics, and the social sciences in general. Let us now look at some of these sciences in the order named.

We start with mathematics—so-called Queen of the Sciences. For a mathematician this might mean Queen "over" the Sciences; you remember the dictum of Pythagoras, who said, "All things are number." But for a physicist, like myself, it cannot mean more than Queen "among" the Sciences. There are three things about mathematics of which I wish to speak: its simplicity and generality, its freedom of invention, and its logicality in accomplishment.

The simplicity and generality of mathematics reside in the simple and general character of the elements that it picks out for study. These are such things as order, number, magnitude, dimensionality, functional dependence, proximity, inclusion, and exclusion, which prove on examination to be quite simple and general notions. Thus, the idea of number is a simple and general one, as, for example, the simple three that characterizes these three fingers or the first three men in the front row, and the general three which characterizes all other collections of three objects. Mathematics is sometimes hard for you and me to understand, not because the mathematician chooses complicated things to talk about, but because he says such complicated things about them. As the study of mathematics becomes more profound, the elements selected for study may even tend to become simpler. Finally, they become meaningless p's and q's on a piece of paper which have no properties beyond those contained in the rules chosen for their manipulation, and no function except in testing the internal consistency, rather than the truth, of the results of such manipulation. It is at this stage that Bertrand Russell makes the humorous comment, "Mathematics may be defined as the subject in which we never know what we are talking about nor whether what we are saying is true."

The freedom of invention in mathematics lies in the liberty of the mathematician to create new elements for study by combination, extension, and analogy, and in his liberty to create his own problems for investigation in which he pursues the behavior of his elements to the furthest depths his mind can penetrate. This liberty is highly prized by mathematicians. As Cantor put it, "Das Wesen der Mathematik liegt gerade in ihrer Freiheit" (The essence of mathematics lies just in its freedom). Nevertheless, this freedom has some peculiar consequences. When the mathematician finds that the problem which he has freely created is too hard for solution, he is still free to create an easier one—which he can solve and publish in a paper. With the freedom to set up all sorts of problems for solution it becomes more difficult to distinguish between trivial and important problems; and the doings of mathematicians may become controlled by temporary fashion or by the opinion of influential cliques. Nevertheless, these difficulties are also present to a lesser degree in the other sciences, and we often have to leave it to the future to decide what really was important.

The logicality of mathematics places a true limit on its creative freedom, since, above all else, the mathematician will demand that the results of his studies shall lead to mutually compatible conclusions. Indeed, at a fundamental level the disciplines of logic and mathematics have now tended to merge. On the one hand, this has come about from the invention of symbolic logic—the so-called algebras of logic—which lead logicians and mathe-

Address at the Graduate School Convocation of Brown University, June 14, 1947.

maticians to use the same kind of economical, shorthand language. On the other hand, and more important, it has come about from the contradictions to which mathematics is now being led as it pushes its studies further by what seem to be logical procedures. This means not only that mathematics provides a testing ground for what is logical, but also that the problems of logic have now become fundamental problems for mathematics itself.

This turn of affairs is so important that I shall try to give some idea of the way in which logical difficulties can arise. Mathematicians love to talk about sets of elements, for example, the set of three elements consisting of this pencil, this paper, and this desk—a perfectly simple idea. With their urge to create, they then like to talk about subsets of such a set, such as the subset containing the two members, pencil and paper or pencil and desk—still perfectly simple—or, even more, to create a new set consisting of all subsets containing two members—not quite so simple. In this way they are led to create a so-called set of all sets, which contains among its elements all possible subsets and all sets of such subsets. This leads to an infinite number of elements which is very pleasing to the mathematicians, since the properties of infinity are among the very things that they especially want to study. But now the trouble begins. On a piece of paper no larger than this we define some simple quantities applying to the elements of the set and define what seems to be a sensible subset. By a small computation we then calculate the value of one of our quantities for the subset and, to our amazement, suddenly obtain the value ½ for a quantity which by definition can only have the values 0 and 1. This is no trivial contradiction such as could be obtained by doing something foolish, like dividing by 0 or reasoning from an incorrect geometrical drawing. The mathematicians themselves do not agree as to what is wrong. Perhaps infinity will always make trouble; perhaps we have defined something that cannot exist; perhaps the logical principle of excluded middle is wrong. These are important questions. The presently shaken foundations of mathematical analysis depend upon the answers.

To the abstractions considered by mathematics, physics adds further elements, taken from the real world, which seem of a more palpable character. These include concepts as to physical space and time, the study of which has led to the Einstein theory of relativity; the concepts of mass, momentum, energy, and electricity, whose deeper treatment now finds expression in modern quantum mechanics; and the concept of fundamental structural particles such as electrons and protons, which constitute the subject matter of nuclear physics. The developments of relativity and of quantum mechanics, and progress in nuclear physics, have been the great happenings in physical science during the present century.

The theory of relativity has two branches: the special theory which treats the relativity of uniform motion in a straight line, and the general theory which treats the relativity of all kinds of motion and is thereby led to a theory of gravitation. The ideas of the special theory, obtained by an appreciation of the actual nature of spatial and temporal measurements, have now permeated the whole thinking of physics. We use them every day in the laboratory, for example, in treating the behavior of high-velocity particles or in calculating the energy of nuclear reactions such as those in the atomic bomb. We no longer find it strange that meter sticks should appear shortened and clocks slowed down, when in motion relative to our own measuring instruments. Indeed, we have now found mesotrons in the cosmic rays which, merely because of their high velocities, last 20 times longer than stationary mesotrons before changing over into electrons. It is now only the cranks, like circle squarers and angle trisectors, and Nazi "Aryan" physicists, who still remain worried by special relativity. The rest of us realize the inadequacy of old-fashioned space-time intuitions based on ancestral experience with slow velocities and have actually grown new space-time intuitions which make high-velocity phenomena seem reasonable and right.

The ideas of the general theory of relativity and its theory of gravitation have had much less impact on the ordinary thinking of physics. This is partly due to the fact that the Newtonian theory of gravitation is plenty good enough for the laboratory, and that the three crucial tests of general relativity have to do with small astronomical effects. In addition, the nonlinear equations of general relativity are extremely troublesome to handle, and this has led to a recent attempt at a linear theory of gravitation, for which I cannot myself see adequate motivation. As nearly as I can see the future, the relativity theory of gravitation provides a basis from which we shall go forward, not backward. Recent English opinions that Hubble's observations disprove the relativity treatment of the recession of the nebulae are not sound; the most that such observations could now do would be to disprove the adequacy of some particular model of the universe. In this connection, I have two pleasing bits of astronomical information to impart. Observations on nearby nebulae, made in recent years at Mount Wilson and at Mount Hamilton, now give strong additional evidence for the belief that the red shift in light from distant nebulae is actually due to their motion away from us, as assumed in the relativity treatment. The final figuring of the 200-inch mirror in Pasadena is now so nearly perfect that we can confidently expect its completion this summer. The mirror will then go up to join the telescope mounting, which waits for it on Mount Palomar, and we can look forward with excitement to the new knowledge of the structure of the universe which this greatest of all telescopes will bring.

We must now turn to quantum mechanics, which has given us the greatest advance in theoretical physics since relativity. As in the case of relativity, this advance has resulted from clear thinking with regard to the actual nature of the results of physical measurement; its consequences have now permeated the thinking of the laboratory; and it has led to new and improved ideas concerning the nature of the physical world. The full development of quantum mechanics, however, can not yet be regarded as complete, since so-called infinity difficulties persist when we attempt to push on.

Among the new and improved ideas provided by quantum mechanics are some striking conclusions concerning the true relation between cause and effect. In agreement with the Heisenberg uncertainty principle, we now see that a complete knowledge of the state of a physical system at any given instant is not sufficient to permit an exact prediction of that system's future behavior. The best that we can do is to make statistical calculations concerning the future behavior that can be expected on the average. As a consequence, we now have to regard the true connection between physical cause and effect as a statistical one and give up the idea that the behavior of the physical world is strictly determined.

This still seems very distressing to Einstein, who says, "Der Herr Gott wurfelt nicht" (The Lord God does not throw dice). Most of us, however, are quite content with the outcome. We do not see how any other outcome would be possible in view of the uncontrolled disturbances introduced by the very act of observation. We appreciate that past intuitions as to the exact connection of cause and effect were based on experience with those very situations where the disturbing effects of observation are too small to be noticed. And we are happy that possibilities for statistical prediction still remain, since, without some possibility of prediction, science itself would surely be destroyed. I must caution you, however, that the opinion of one good physicist that the uncertainty principle brings free will and moral responsibility back into the world can hardly be regarded as sensible. As far as I know, moral responsibility has never left the world and, indeed, could hardly be helped by a principle which makes physical happenings, to the extent that they are not determined, take place in accordance with the laws of pure chance.

Now to nuclear physics, where we delightfully arrive at an old-fashioned kind of science in which the experimenters find out new things faster than the theoreticians can predict them, and sometimes in contradiction thereto. The important recent events in this field have been the experimental discovery of the new particles—neutron, positron, and mesotron—now added to the previously known electron and proton, and the experimental study of the properties and behavior of the different kinds of nuclei which are composed from such fundamental particles. It is these different kinds of nuclei which give us the different kinds of atoms and substances that exist in the world. It will be of interest to mention three examples of the interplay between experiment and theory in this field of work.

The existence of the positron—a positively charged electron—had not been theoretically predicted before its discovery in cosmic rays by Anderson, but an existing attempt by Dirac at a theory of the proton was then immediately seen to give at least a partially satisfactory explanation of the positron instead. The existence of a particle like the mesotron had been theoretically assumed beforehand by a Japanese named Yukawa, in order to explain the forces holding protons and neutrons together in nuclei. Actual mesotrons, which are like electrons but 200 times as heavy and with an average life of only 2.15 millionths of a second before they change over into electrons, were then discovered in cosmic rays by Neddermeyer and Anderson, but have so far not proved successful in explaining the forces that hold protons and neutrons together. The disintegration of uranium nuclei by fission, which led to the invention of the atomic bomb, had not been theoretically predicted before its discovery by Hahn and Strassmann. However, immediately on discovery, this phenomenon was seen to be reasonable on the basis of simple theoretical considerations of Bohr as to the nature of heavy nuclei.

I must complete these words on nuclear physics with a remark about a horrible little particle called the neutrino. No direct effect from neutrinos has ever been found; their existence has been assumed merely for the purpose of carrying away energy and momentum that would otherwise seem to be destroyed. This is very unsatisfactory. Perhaps it would be better to abandon the idea of the conservation of energy rather than to invent a new particle that one can never find.

I hope that the foregoing gives some right ideas as to what is happening in physics. There are other things which I should like to talk about, such as the important work of Prof. Lindsay, of this University, on the philosophical bases of physics, but these deep matters will have to be a subject for private conversation with him.

We now come to the science of chemistry, which adds, to the physical notion of the existence of matter in general, the more specific concept of many different kinds of chemical substance and of chemical reaction from one kind of substance to another. In this connection, however, I must now tell you of an important change that has taken place in our thinking. With the help of the new quantum mechanics, and of our new ideas as to the nature of electrons and nuclei, we now find it possible to give an adequate explanation of chemical substance and chemical reaction in terms of the concepts of physics. Thus, a minor revolution has taken place in the organization of science. We now no longer regard chemistry as a science separate from physics but rather as one of the group of physical sciences in which, for example, we also include kinematics, mechanics, and electrodynamics.

I call this revolution a minor one for several reasons. The explanation of chemistry in terms of physics is a revolution that was long impending and, indeed, expected and desired by many chemists, but one which could not be consummated until quantum mechanics had furnished the proper tools. The revolution has not eliminated the necessity of providing different kinds of atoms to explain chemical substances and reactions, but has merely transferred to physics the task of building such atoms out of electrons and nuclei. Finally, the revolution has had little impact on much significant chemical work, since the theoretical possibility of going back to quantum mechanics for explanation is often neither practical nor profitable. Thus, it would often be foolish to describe in quantum-mechanical language the results of the work in physical and inorganic chemistry which has been carried out at Brown University by Prof. Kraus and his colleagues, and which has been so important in peace and in war. Similarly, in the important applications of organic chemistry to biological problems, quantum-mechanical language is not usually appropriate.

Let us now turn to the field of biology. To a physicist who, like myself, still remains a human being, this would seem to be a wonderful science, with possible answers to all the important questions of life. It would be so easy if we could just say that "life" is the new abstraction that must now be added to those of physics and chemistry to get the science of biology, and that this science will then tell us all we want to know about life, death, freedom, and immortality. I think, however, that actually we have to say something much more nearly like the following.

We now add a new kind of abstraction, that of the so-called living organisms. These are material bodies which can maintain themselves, at least for a time and in a properly selected environment, in a substantially steady state through a continuous interchange of matter, energy, and entropy with their surroundings; which are irritable to external stimuli and can adjust to moderate changes in environment; which, under suitable conditions, can exhibit possibilities for growth, change in form, and reproduction in kind; which present themselves to our attention as a series of many different but not unrelated species; and which exhibit the influence of a long past history of evolutionary change as an essential determinant of present structure and behavior.

The difference between biological and physical-chemical work is frequently characterized by the intimate dependence of biological material on its environment and its essential dependence on the specific history of its past evolution. Indeed, the essence of a good physical-chemical experiment, when we are not concerned with cosmological problems, is usually to free the outcome from such dependence. Thus, a mixture of hydrogen and oxygen should explode whether we prepare the gases ourselves and store them in bottles or buy them already prepared and stored in tanks. But the behavior of plants and animals is always delicately dependent on sunlight and food and is essentially dependent on a particular series of evolutionary changes that have taken place in the recent past—in the last 100,000,000 years or often much less.

I wish that I were competent to tell you about the extraordinarily interesting things that are happening in biology. The last sweeping innovation in this field still appears to be the genetic explanation of the factors controlling heredity, given by Morgan and his colleagues. It is comforting to appreciate the extent to which our own behaviors are determined by the genes, provided by our fathers and mothers, since we can't do anything about it ourselves. Recent happenings in genetics include: elaborate mathematical analyses of the rates at which evolutionary changes can take place through gene mutation; laboratory observations on the action of the environment in selecting for survival different mutant forms of bacteria; further experiments on the artificial production of mutations and on the possibility for the specific control of such mutations; and studies of the chemical processes by which genes determine the behavior of the rest of an organism, which have been greatly furthered by Beadle's recent introduction of *Neurospora* as an especially convenient genetic material.

In the field of biochemistry great things are also happening. They include studies on the action of enzymes—hormones, vitamins, and others—in controlling biochemical reactions; advances in immunology, where the lock-and-key-like behavior of antigen and antibody seems significant; further work on the structure of the proteins, where the template-like pattern of complicated molecules plays such an important role; and studies of the tobacco virus and other similar viruses, where such a simple physical-chemical structure is found that we have to regard these substances as lying at the boundary between inert and living matter. To the physicist, biology is the green pasture beyond the fence where it would be good to roll in the long grass.

We must now pass on to psychology, which is the least abstract of the sciences for which we shall have time. Here it would be simple if we could just take "mind" as the further abstraction from reality that has to be added to those of biology to arrive at psychology, but things now become so complicated that the psychologists themselves are not yet well agreed. For myself, I should at the present moment like to say something about as follows. We now add the new abstraction of a special kind of behavior, commonly called mental, which characterizes the activity of individual organisms as a whole, which frequently appears purposive in character, and which includes the verbal behavior of ourselves and of others when giving an introspective account of our own sensations, feelings, and thoughts. Certainly a very poor statement, containing ill-defined and unanalyzed concepts, but at least omitting or covering up in its verbiage that bothersome word "mind." We are indebted to the work of the behaviorists, including the important contributions of Prof. Hunter, of this University, for a view of psychology which emphasizes observable behavior rather than hypothetical mind. This leads at once to the first of two comments on psychology.

As a consequence of the ease with which we often distinguish between what we call physical, and what we call mental, behavior, it seemed natural in the past—and indeed long ago in the past—to introduce the two separate abstractions of body and of mind. By doing so, however, we immediately threw ourselves open to that sea of troubles, the so-called body-mind problem. Having divided our man up into a separate mind and body, what should be the interaction between these two disparate entities, and how should we ever get the whole man back together again? Increasingly in the last years these theoretical difficulties have been augmented through observation and practice in the field of psychosomatic medicine—for example, recognition in military medicine of the psychogenic factors in the nevertheless real rheumatism of soldiers. In general, we often find, on the one hand, unconscious desire to escape into ill health producing the corresponding physical symptoms, and, on the other, the presence of bodily health fostering mental serenity and sanity. In such connections it seems probable that our scientific abstractions will in the future become more appropriate.

The second comment has to do with the revolution in psychology brought about by the psychoanalytic doctrine of Freud. As to this, much controversy has raged, and some academic psychologists are still disturbed, even when the language and explanations of psychoanalysis are already issuing from their lips. From a pragmatic point of view psychoanalysis certainly proves useful—in the treatment of neuroses, in the treatment of a restricted class of psychoses, and, above all, in our daily lives when we must try to understand the motives both of ourselves and of others. Indeed, in view of its present expense, perhaps we ought to say, "What this country needs most is a good five-cent psychoanalysis." The various methods of so-called "short therapy," recently introduced through the exigencies of military psychiatry, may be a step in that direction. From a theoretical point of view much remains to be done. The better incorporation of psychoanalytic doctrine into the main body of psychology must be pursued further; the already-fruitful study of the relations between psychoanalysis and cultural anthropology must be continued; and, above all, the present vigorous development of psychoanalytic theory must not be stopped, even by Freudian scholastics who regard themselves as the only true guardians of the pure faith.

Psychology must be the last of the various sciences to which we give detailed attention. We have now gained a reasonable idea of the kind of things happening in the different sciences and the methods by which we proceed from one science to another by including further features of the actual, concrete world around us. By continuing the procedure we could presumably go on to social psychology and the social sciences in general, although perhaps with considerable difficulty and uncertainty.

So far consideration has been given to the so-called pure sciences, each of which has the task of determining the principles that explain its own particular field of phenomena. We must now give a word to the so-called applied sciences, in which these principles are employed in other fields. For the layman, the term applied science usually implies application to practical or industrial ends, such as the navigation of ships or the manufacture of radios, but for the scientist, the term also includes, as of special interest, the application of the principles of one science to another.

Of all the applied sciences, applied mathematics is the most important, since its methods are needed and used in all the other sciences. This usefulness does not seem surprising, for, as we have seen, mathematics selects for its study those simple and general elements which will also often be present in the situations studied by other sciences. In addition, mathematics has invented such a clear and economical language for the logical treatment of complicated problems that the other sciences also find it useful as they themselves become more complicated. As an illustration, we, nowadays, even find psychologists writing books on that very difficult subject, the mathematical theory of statistics—and they do not do so badly at it either.

In view of the importance of applied mathematics, I wish to pay special tribute to Dean Richardson who, in addition to his own notable contributions to pure mathematics, has had the sagacity and ability to foster the establishment and activities of the Brown University Institute of Applied Mathematics. We may look on the present and future accomplishments of this Institute with satisfaction and confidence.

Just as mathematics, the most abstract of the sciences, can be applied to all the others, each of the various pure sciences can be applied to those that stand above it on the ladder of abstraction. Thus, the applications of physics and chemistry to biology are now proving extremely fruitful in the explanation of biological phenomena that we could not otherwise understand. Indeed, the study of biology with the help of physical-chemical methods is a rich vein which will not be worked out for many decades. This brings us to a consideration of the problem of the extent to which the phenomena of any science can be explained in terms of the more abstract sciences below it. Perhaps all of biology and psychology—life and mind themselves—might be explained in terms of physics and chemistry. This would be pleasing to some persons, including some pretty good scientists.

This important question, as to the extent to which a given science can be explained in terms of more abstract ones, is always present in my own thinking. I believe that the answer depends on the extent to which the science in question has really introduced genuinely new abstractions from reality, beyond those already incorporated in the preceding sciences below it. On this basis, I myself feel led to the following tentative conclusions: on the one hand it is my conviction that the phenomena of biology and psychology will never be found to contradict the principles of physics and chemistry. On the other hand, it is my belief that such principles will perhaps not prove sufficient for the full explanation of biology and will almost certainly not be sufficient for the explanation of psychology.

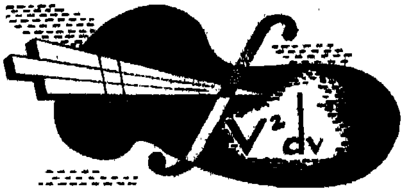
Finally, I wish to say something about the application of the sciences to so-called practical ends. In the first flush of enthusiasm for the industrial revolution that resulted from the practical applications of science, it was felt that the consequences of such application could only be for the good of man. As we have seen more of these consequences, however, and thought more deeply on such matters, we now realize that the practical results of science will be good or evil, in the ethical sense, depending on the nature of the application. This conclusion is dramatically illustrated in the scientific development of atomic energy which can be used either for peaceful or destructive purposes. The possibilities for evil are clear in the development of a weapon which could be used, in a surprise attack before any declaration of war, for the destruction of a score of cities and most of the inhabitants thereof.

The evils that can result from wicked application do not mean that science itself is evil. Each pure science merely gives an objective account of the facts which it finds in its own field of study. These facts are ethically neutral; it is only their application that can lead to evil rather than good results. Moreover, from a broader and deeper point of view, the pursuit of these ethically neutral facts must itself be regarded as a good. It is a spiritual good, since knowledge of the true nature of the world in which he lives should increase the intellectual dignity of man. It is a practical good, since it is only through knowledge of the actual facts that men of good will can plan for their application to good rather than evil ends. Keeping certain facts secret, as in the field of atomic energy, can be temporarily important and serve a useful purpose, but can make no fundamental contribution to the prevention of evil.

In the control of evil, psychology and the social sciences have a special role to play. This resides in the provision of information and advice concerning the human and social consequences of different courses of action—for example, in establishing international control of atomic energy. It does not reside in any ethical quality pertaining to these sciences themselves. The objective findings of psychology are as ethically neutral as those of any other science and can be applied not only to good but also to evil ends, as in determining the most effective form for sinful propaganda such as that of the Nazis. Even when the anthropologist studies the moral practices and systems of different tribes and nations, his findings remain objective and ethically neutral and contain, as science, no recommendation of one set of moral values over another. Science is concerned with judgments of existence, not judgments of value.

The judgments of men and of nations of men as to what is good depend partly on the static factors of childhood training and of prevailing custom, but partly also on the dynamic consequences of the new spiritual insights which determine the teachings of ethical leaders and which each of us may sometimes experience in the closet of his conscience. As the judgment is being reached, science can advise as to the nature of the facts. When the judgment is being advocated, science can point out its consequences. When the judgment is being implemented, science can supply tools for the accomplishment. But in its final essence, ethical judgment is a creative activity of man.

It is my faith that the ethical insight and scientific intelligence of man are such that the control of evil is possible. I am sure that humanity will continue to encounter great troubles, but I do not think that civilization will destroy itself. To surmount our troubles, we shall need courage, patience, clarity of thought, and sincerity in the advocacy of fair and reasonable courses of action. For these virtues we may pray, each in his own fashion.



NEWS
and Notes

The National Science Foundation bill, after having been passed by both the House and Senate, was vetoed by President Truman on August 6. At the same time the President urged that Congress, when it reconvenes in January, reconsider and pass an acceptable bill. The veto message stated that the bill implied "a distinct lack of faith in the democratic process" and, in effect, would "vest the determination of vital national plicies, the expenditure of large public funds, and the administration of important governmental functions in a group of individuals who would be essentially private citizens." It went on to say that "full governmental authority and responsibility would be placed in 24 part-time officers whom the President could not effectively hold responsible for proper administration. Neither could the director of the Foundation be held responsible by the President, for he would be an appointee of the Foundation and would be insulated from the President by two layers of part-time boards."

Watson Davis, director of Science Service, in a release dated August 7, has aptly commented: "Scientists in all fields are disappointed that the bill did not become law. Some of them point out that control of research funds available for grants are left, by default, largely in the hands of the Army, Navy, and Air Force . . . they want to see research *predominantly in* civilian hands, and the military research bureaus have agreed with them. Scholarships for young research scientists were authorized in the bill as an aid to filling the depleted ranks of scientific investigators. This is considered one of the most important functions of the foundation, now delayed."

Network television operations were expanded on June 27, when station WNBW (NBC) went on the air. Located in Washington, atop the Wardman Park Hotel, the new station is linked by coaxial cable with station WNBT in New York. Using a new postwar television transmitter, type TT-5A, developed by RCA, the station will operate on Channel 4. The picture signal of the transmitter is built up to 20.7 kw. when radiated from the turnstile antenna on the 350-foot tower on the hotel. Network operations on a national scale are to be considerably expanded during 1948. Present coaxial cable facilities now extending from New York to Philadelphia, Washington, Richmond, and Charlotte, North Carolina, will be connected with a cable already installed between Jacksonville, Florida, Atlanta, Jackson, Mississippi, Shreveport, Louisiana, and Dallas. Installation of the cable from Charlotte through Augusta to Atlanta and from Dallas to Los Angeles will complete the first coast-to-coast network.

About People

Donald A. Keys, chairman, Department of Operative Dentistry, University of Nebraska, will give a series of lectures beginning August 23 to members of national dental associations in Norway, Sweden, and Denmark, to help bring dentists in these countries up to date on recent American developments in dentistry. Dr. Keys will return late in September.

Charles E. Kellogg, chief, Division of Soil Survey, U. S. Department of Agriculture, returned July 24 from a three-month visit in Europe and Africa. He attended the Mediterranean Conference of Pedology in southern France and Algeria, took part in a small conference held in Paris to plan for reorganization of the International Society of Soil Science, and visited the Rothamsted Experimental Station and the University College of North Wales. As the guest of INÉAC (Institut National pour l'Étude Agronomique du Congo Belge) he traveled for 5 weeks in the Belgian Congo, visiting experimental stations and studying soils and agriculture in the field.

Robert J. Coffey, *former fellow of the* Mayo Foundation, has been appointed professor of surgery, Georgetown University, Washington, D. C., effective July 1.

R. H. Rigdon, formerly professor of pathology, University of Arkansas Medical School, has been appointed professor of experimental pathology and director, Laboratory of Experimental Pathology, University of Texas Medical Branch, Galveston.

Winthrop Perrin Haynes, geologist, Standard Oil Company of New Jersey, has been appointed visiting lecturer in geology, Harvard University, for the academic year 1947–48. Dr. Haynes will give courses in Petroleum Geology.

Ralph T. Holman, now on leave from the Department of Physiological Chemistry, University of Minnesota, will join the Department of Biochemistry and Nutrition, Agricultural and Mechanical College of Texas, about February 1, 1948. Dr. Holman is now doing postdoctorate work at the Nobel Institute of Medicine, Stockholm, and before returning to this country will spend several months with Prof. Tiselius at Uppsala.

Arthur W. Grace, professor of clinical dermatology and syphilology, Long Island College of Medicine, left on July 27 for a 7-week lecture tour of South America during which he will visit 6 countries. His trip is sponsored by the E. R. Squibb & Sons Inter-American Corporation and the Squibb Institute for Medical Research as part of a program to stimulate the exchange of advances in research, practice, and medical education between the two continents.

Raymond H. Fletcher, former director of instruction, Highland Park Schools, has joined the Texas regional office staff of Rohrer, Hibler and Replogle.

Fritz Schlenk, professor of biochemistry, University of Texas Medical School, has been appointed professor, Department of Bacteriology, Iowa State College, and **Paul Arne Hansen,** recently associate bacteriologist in charge of a field station for the U. S. Department of Interior at Hampton, Virginia, has been appointed associate professor.

Robert B. Dean, formerly at the University of Hawaii, **Hans Heymann,** Harvard University, **Francis J. Reithel,** California Institute of Technology, and **Donald F. Swinehart,** Los Alamos Laboratory, have recently been appointed assistant professors in the Department of Chemistry, University of Oregon, Eugene.

William B. Deichmann, head of a Division of Toxicology, Kettering Laboratory of Applied Physiology, University of Cincinnati, since 1939, has been named associate professor of physiology and pharmacology and head, Division of Pharmacology, Albany Medical College, Albany, New York.

Lawrence M. Richards, formerly on the research staff of the DuPont Experiment Station, Wilmington, Delaware, is now associated with the Stanford Research Institute as a research chemist.

John B. Patton, geologist, Magnolia Petroleum Company, Mt. Vernon, Illinois, has been appointed research associate in economic geology, Department of Geology, Indiana University.

L. C. Graton, professor of mining geology, and **Francis Birch,** professor of geophysics, both of Harvard University, have been sent to Iceland by the Committee on Experimental Geology and Geophysics at Harvard to observe geysers and other thermal phenomena.

Industrial Laboratories

The Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, has recently announced that **Robert P. Parker,** former head, Pharmaceutical Section, Research Department, has been appointed assistant research director; **Erwin Kuh,** Pharmaceutical Research Department, research associate; and **James Smith,** formerly of the University of Virginia, and **J. J. Denton,** Organic Section, Research Department, assistant chief chemists.

At the General Electric Research Laboratory David Harker and J. S. Kasper have developed a method for determining the way in which atoms are arranged in a complicated crystal. The method, which involves mathematical analysis of the patterns obtained when X-ray beams are shot through the crystals, may furnish important information about the structure of proteins. The atoms of a crystal, which have some regular arrangement, diffract the X-rays, and the pattern is recorded on a photographic plate. Although it has been possible to measure the intensities of the rays extending from the crystal and making up the diffraction pattern, it has not been possible to determine their phases. With the new method the phases may be determined from the intensities of the rays, the mathematical analysis then providing a picture of the crystal's structure.

Merck & Co., Inc., has named Randolph T. Major vice-president and scientific director; John H. Gage, treasurer; and Per K. Frolich, director of research and development, succeeding Dr. Major.

H. A. Murray, chief chemist and assistant plant manager, Best Foods, Inc., Buffalo, New York, since 1934, has been appointed manager of the Buffalo plant, succeeding **V. B. McLean,** who has retired. **Edwin L. Sexton** has been appointed chief chemist succeeding Dr. Murray.

William Reiner-Deutsch, microbiologist, Industrial Testing Laboratories, New York City, has been appointed director of research.

Willis F. Harrington, vice-president and member of the Executive Committee, E. I. du Pont de Nemours & Company, resigned August 1. Mr. Harrington, who will continue to serve as a member of the Board, is succeeded by **J. Warren Kinsman,** general manager, Fabrics and Finishing Department.

Colleges and Universities

The Department of Horticulture, Michigan State College, has recently received an appropriation of $150,000 from the State Legislature for facilities and equipment for research.

Case Institute of Technology has announced the appointment of **T. Keith Glennan,** an executive of Ansco Division, General Aniline & Film Corporation, Binghamton, New York, and during the war, director, U. S. Navy Underwater Sound Laboratory, as its new president, succeeding **William E. Wickenden,** who will retire September 1.

Kansas State College of Agriculture and Applied Science is the recipient of a recent donation of $16,500 from the milling industry, to be used for equipping a pilot plant bakery to be operated in connection with the Department of Milling Industry. The new facilities will be used for research, wheat quality evaluation, and student training programs.

Meetings

The Mathematical Association of America will hold its 29th summer meeting at Yale University, New Haven, Connecticut, September 1–2, in connection with the summer meeting and colloquium of the American Mathematical Society and the meeting of the Institute of Mathematical Statistics. The first session, to be held at 2:30 P.M. September 1, will include "Atomic Energy," R. C. Bacher, U. S. Atomic Energy Commission, and a symposium on "Mathematical Problems at the College Level." Participants will include: George Polya, Leland Stanford University, chairman; H. F. MacNeish, Brooklyn College, and J. L. Synge, Carnegie Institute of Technology, co-chairmen; and H. S. M. Coxeter, A. M. Gleason, P. G. Helsel, Tibor Rado, L. M. Kelly, and E. P. Starke, contributors. The second session, at 9:00 A.M. September 2, includes: "Mathematics for the Liberal Arts Student," Carl Allendoerfer, Haverford College; "The Mathematics Program in the College of the University of Chicago," E. P. Northrop, University of Chicago; and a symposium on "Computing Machines" at 10:00 A.M., in which H. H. Aiken, Harvard University, and John Von Neumann, Institute for Advanced Study, will participate.

The 77th meeting of the American Astronomical Society will be held September 3–6 at Dearborn Observatory, Northwestern University, Evanston, Illinois, at the invitation of Oliver J. Lee, director of the Observatory. A special session will be held September 6 at Yerkes Observatory, Williams Bay, Wisconsin, to celebrate the 50th anniversary of the founding of the Society and Yerkes Observatory. Papers by members will be presented during the morning and afternoon sessions, September 4, and the morning session, September 5. The business meeting is also scheduled for September 4, and the teachers' conference for the afternoon of September 5.

The Chicago Section, American Chemical Society, will hold its third All-Day Technical Conference on December 26 at Hotel Sherman, Chicago, in conjunction with the 114th AAAS meeting. A joint three-day chemistry program will be featured by three symposia organized by the Chemistry Section, AAAS, and by a series of divisional meetings conducted by the Chicago Section, ACS. Although this conference is being sponsored by the local Section, contributions from other areas will be welcome. Titles must be submitted by September 20 to the following divisional chairmen: (I) Biological and Pharmaceutical—L. W. Clemence, Abbott Laboratories, North Chicago, Illinois; (II) Chemical Education—T. A. Ashford, Department of Chemistry, University of Chicago; (III) Agricultural and Food—G. A. Crapple, Wilson & Company, 4100 S. Ashland Avenue, Chicago 9; (IV) Industrial and Engineering—Kenneth Anderson, Northwestern Technological Institute, Evanston; (V) Inorganic and Analytical—George Gibson, Illinois Institute of Technology, 3300 Federal Street, Chicago 16; (VI) Organic—M. M. Gladstone, Emulsol Corporation, 59 E. Madison Street, Chicago 2; (VII) Petroleum—S. B. Becker, Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 5; (VIII) Physical—H. E. Ries, Jr., Research and Development Department, Sinclair Refining Company, East Chicago, Indiana; (IX) Radiochemistry—W. F. Libby, Institute for Nuclear Studies, University of Chicago. Further information may be obtained from Miss Mary Alexander, Conference Committee Secretary, Universal Oil Products Company, 310 S. Michigan Avenue, Chicago 4.

The Oregon Geography Council will hold its fall conference October 4, at Memorial Union Building, Oregon State College, Corvallis. The evening dinner program will be held in the Benton Hotel. The morning session on the general topic, "Regional Planning: A Practical Application of Geography," will offer lectures by E. L. Ballard, Oregon State College, "Planning for Agriculture in Oregon"; F. Arpke, Bonneville Power Administration, "Business and Industrial Planning in Oregon"; and Chester Sterrett, Portland Chamber of Commerce, "Urban Planning in Oregon." During the afternoon program on the topic, "The Climatic Factor in Geography," Phil Church, University of Washington, will speak on "Climatic Regions as an Approach to World Geography," after which there will be sectional meetings to discuss instructional problems in modern geography. At the evening meeting, new officers will be installed, and Howard H. Martin, University of Washington, will speak on "Geography in World Affairs." Further information may be secured from J. Granville Jensen, Department of Geography, Oregon State College, Corvallis.

The Tri-State Field Conference, consisting of staff members and graduate students of universities, colleges, and State Geological Surveys in Wisconsin, Iowa, and Illinois, is to be held this year in Wisconsin, probably early in October. W. H. Twenhofel will lead the group through the Silurian of eastern Wisconsin. L. M. Cline, Department of Geology, University of Wisconsin, is chairman of the Arrangements Committee.

The Electrochemical Society, Inc., is planning a Boston Congress on October 15–18. Headquarters for the Congress will be the Copley-Plaza Hotel. Scientific sessions will be held on such topics as The Per Salts, Electrochemical Methods of Laboratory Control, Electrodeposition—1947, New Primary Cells, and Electro-organic Syntheses. Charles G. Harford is chairman of the local committee making arrangements for the meetings.

Elections

The Pacific Section, Botanical Society of America, at a recent meeting, elected the following officers: Lyman Benson, Pomona College, president; Ralph Emerson, University of California, Berkeley, secretary-treasurer; and Walter S. Phillips, University of Arizona, representative on the Council of the Pacific Division, AAAS.

The Institute of Navigation, at its annual meeting on June 23–24 in Washington, D. C., elected the following national officers for the academic year 1947–48: Commodore G. G. McLintock, USMS, special assistant to the Commandant, U. S. Maritime Service, Washington, D. C., president; Capt. P. V. H. Weems, USN (retired), Annapolis, Maryland, vice-president; Paul Rosenberg, president of Paul Rosenberg Associates, New York City, technical adviser; and Samuel Herrick, professor of astronomy, University of California at Los Angeles, executive secretary.

NRC News

Lewis H. Weed, chairman of the Division of Medical Sciences, recently returned from England, where he received the honorary degree of Doctor of Laws from Birmingham University. The degree was conferred upon Dr. Weed on July 4 during ceremonies at the University at which the chancellor, Anthony Eden, officiated. The citation accompanying the degree referred to Dr. Weed as "the greatest living authority on the nature and functions of cerebrospinal fluid" and paid tribute to his work in embryology as well as to his outstanding work with the military services during the war years. Dr. Weed recently resigned as professor of anatomy at Johns Hopkins Medical School in order to devote full time to his duties as chairman of the Division of Medical Sciences.

Recent Deaths

John Samuel Houser, 66, chief, Department of Entomology, Ohio Agricultural Experiment Station since 1926, died June 25 at his home in Wooster, Ohio.

Arthur LaMotte, 76, formerly manager, Technical Service Section, Explosives Department, E. I. du Pont de Nemours and Company, died July 17 in Oakland, California.

Leo Everett Hudiburg, 49, professor of physics, Kansas State College, and former assistant dean, School of Arts and Sciences, died July 23 at his home in Manhattan, Kansas.

Treat Baldwin Johnson, 72, Sterling professor of organic chemistry, Yale University, prior to his retirement in 1943, died July 28 at his home in Bethany, Connecticut.

Charles Franklin Curtiss, 83, dean emeritus of agriculture, Iowa State College, died July 30 in Ames, Iowa.

Hubert Lyman Clark, 77, associate professor emeritus of zoology, Harvard University, died July 31 in Cambridge, after a month's illness.

Robert B. Thomson, 76, professor emeritus, and head, Department of Botany, University of Toronto, until his retirement in 1941, died July 31 in Agincourt, Ontario, following an illness contracted last year while representing Canada at the All-India Scientific Congress.

Orrin C. Blair, 69, chairman, Lynn Cancer Clinic, died August 3 at the Lynn Hospital, Massachusetts.

Henry Harold Higbie, 64, professor of electrical engineering, University of Michigan, died August 3 in Ann Arbor, after a brief illness.

D. E. Lea, 37, British radiobiologist, died recently in England as the result of an accident. Dr. Lea was the author of *Actions of radiations on living cells* (reviewed in the April 25 issue of *Science*) and, in collaboration with D. G. Catcheside, had formulated a detailed theory of induced lethals in *Drosophila*.

The editorial offices of *Cancer Research* have been moved from New Haven, Connecticut, to the Medical School, University of Pennsylvania, Philadelphia 4. Balduin Lucké is succeeding S. Bayne-Jones as editor, and Morton McCutcheon will serve as associate editor. Edward W. Shrigley, of New Haven, continues as editor of the Abstracts Section.

Rich collections of fossils, made in the course of his field work in the Cerro de Pasco region of central Peru, under a grant from the American Philosophical Society, were sent in 1941 by William F. Jenks, University of Rochester, to Otto Haas, American Museum of Natural History, for identification. Since then, collections of Peruvian fossil invertebrates made from 1943 to 1946 by Norman D. Newell, of the Museum and Columbia University, Bernhard Kummel, Bureau of Economic Geology, Austin, Texas, and Dr. Jenks have been added to the initial material. Most of these collections are of Mesozoic age.

Although it was originally planned that Dr. Haas should take care of the study of all the collections from the Cerro de Pasco region, because of the addition of new materials and the unexpected multiplication of the total of fossils by means of chemical preparation, the work is being divided among several specialists. A report on charophytes from various regions and horizons, prepared by Raymond E. Peck and Mr. Reker, both of the University of Missouri, is intended for publication in the Museum's *Novitates;* John W. Wells, Ohio State University, will study the Anthozoa and Porifera; Dr. Newell, the pelecypods; Dr. Kummel, Triassic cephalopods; and Dr. Haas, the post-Triassic cephalopods and the gastropods. Some important groups, especially the brachiopods, second only to the mollusks in number of specimens, are still waiting for specialists to undertake their study. All of this work is being done in close cooperation with the Geological Institute of Peru.

According to present plans, a series of paleontological monographs on the Mesozoic of Peru will eventually be published, probably in the Bulletins of the American Museum of Natural History. As yet, only two preliminary papers have been published, one by Vokes and Haas (*J. Paleontol.*, 1944, 18, 293–294) and one by Haas (*Bull. geol. Soc. Amer.*, 1946, 57, 1198–1199). Aside from Peck's and Reker's work, mentioned above, only the post-Triassic ammonites have been identified by Dr. Haas, and a preliminary age determination of Liassic corals has been made by Dr. Wells. Work on Triassic gastropods and pelecypods by Drs. Haas and Newell, respectively, has been in progress for some time. A Triassic age (upper Middle to Upper) is assigned to most of the fossils from the limestones between Cerro de Pasco, Huachón, and Tilarnioc (central Peru).

Excerpta Medica, Inc., of Amsterdam, has recently undertaken a project involving the publication of 15 journals containing abstracts of world literature in the fields of clinical and theoretical medicine. All abstracts will be published in English and will be prepared by about 3,000 specialists all over the world under the supervision of some 400 editors. It is intended that the journals will both replace and extend such publications as the *Zentralblätter* and *Berichte*. Each sectional journal will be issued monthly. The sections include: (I) Anatomy, Anthropology, Embryology, Histology; (II) Physiology, Biochemistry, Pharmacology; (III) Endocrinology; (IV) Public Health, Social and Industrial Medicine; (V) General Pathology, Pathological Anatomy, Bacteriology; (VI) Internal Medicine; (VII) Pediatrics; (VIII) Neurology and Psychiatry; (IX) Surgery; (X) Obstetrics and Gynecology; (XI) Oto-, Rhino-, Laryngology; (XII) Ophthalmology; (XIII) Dermatology and Venereology; (XIV) Radiology; and (XV) Tuberculosis. General medical direction is in the hands of a Chief Editorial Board consisting of M. W. Woerdeman, A. P. H. A. de Kleijn, and W. P. C. Zeeman. The Williams & Wilkins Company, Baltimore 2, Maryland, is the sole agent for the United States, Canada, and Central America. A free booklet describing the series is available on request.

Applications of atomic power and its by-products in industry, medicine, and other peaceful fields will be the subject matter of a new monthly, *Nucleonics*, to be published by McGraw-Hill, beginning in September. Each issue will contain 80 or more editorial pages and no advertising. The subscription price is $15.00 per year.

A national mental health program, authorized by Congress in 1946 and implemented on July 8 by an appropriation of $7,500,000, will encompass (1) increased research in problems of mental health, (2) training of urgently needed personnel, and (3) increased support and stimulation to states in the development of adequate programs. In achieving the first of these objectives approximately $400,000 will be spent during the fiscal year 1948 in the form of grants-in-aid and research fellowships. Over $1,000,000 will be spent for grants to nonprofit institutions for developing and improving facilities for training personnel as well as for providing training stipends for 70 graduate students in psychiatry, 41 in clinical psychology, 40 in social work, and 58 in psychiatric nursing. A sum of $3,000,000 is appropriated to states for their local programs, which are to include one outpatient clinic for each 100,000 of the population, services to rural areas through traveling clinics, and demonstration clinics to be operated by the Public Health Service. The remainder of the funds will be used for field studies in mental hygiene and operation of Public Health Service hospitals for drug addicts and the mentally ill at Lexington, Kentucky, and Fort Worth, Texas. An additional appropriation of $850,000 is to provide for purchasing a site and drawing plans for a National Institute of Mental Health, *to be located in the vicinity of the District* of Columbia.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, lists the following wanted chemicals: 2-isoimidazole; 2,1,3-triazole; 4,1,2-triazole; furazan; 1,2,4-oxadiazole; 1,3,4-oxadiazole; isotetrazole; pyridazine; pyrazine; quebrachitol; d-quercitol; cellopentaose; α-benzylpyridine; hydroxytyramine; epinine; 2,2-difluoropropane; glucose 6-phosphate; 2-phosphoglyceric acid; 3-phosphoglyceric acid; and hygrine.

A comprehensive list of powder metallurgy patents to date, including a brief abstract for each invention, has been compiled by Raymond E. Jager and Rolla E. Pollard, of the National Bureau of Standards, and is now available as NBS Publication M184 (*United States patents on powder metallurgy*) from the Superintendent of Documents, Washington 25, D. C., at $.30 per copy.

Make Plans for—

American Institute of Electrical Engineers, Pacific General Meeting, August 26–29, San Diego, California.

Mathematical Association of America, September 1–2, Yale University, New Haven, Connecticut.

Fourth International Cancer Research Congress, September 2–7, St. Louis, Missouri.

American Astronomical Society, 77th Meeting, September 3–6, Dearborn Observatory, Evanston, Illinois.

First International Biometric Conference, September 5–6, Marine Biological Laboratory, Woods Hole, Massachusetts.

American Psychological Association, September 9–13, Detroit, Michigan.

American Roentgen Ray Society, September 14–19, Atlantic City, New Jersey.

American Chemical Society, 112th National Meeting, September 15–19, New York City.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS

by Readers

The scientific world has no direct concern with the political side of the conference between the Indonesian and Netherlands Governments deciding on their future relations. These negotiations, however, also involve the status of the scientific institutions on Java and Sumatra, which are of much more than local significance. This is to be regretted, since it is generally admitted that the direction of scientific work and its results have no national or political boundaries. This was typically shown in Java, where men from all nationalities have contributed to scientific biological knowledge of the tropics. Swiss (Hasskarl, Zollinger, Bernard, Vischer, Schweizer), German (Junghuhn, Rumphius), Danish (Jensen, Gandrup), Swedish (Booberg, Tengwall), American (Rands, Yampolski), Chinese (Tan Sin Hok, Tung), Indonesian, and Dutch scientists all contributed while being employed at government and private research institutes and experiment stations. Appointment to such positions was dictated not by political considerations but by qualification for the job. This made the agricultural experiment stations in the Netherlands East Indies among the best in the world.

Recently, alarming news has come from Java concerning these scientific institutions. Plans had been formulated to have all scientific services placed on a commonwealth basis. The Indonesians, however, have claimed complete control over them. This has been ceded to them by a preliminary Netherlands Government decree. Indonesians have been appointed as directors of the institutions, irrespective of their qualifications. Thus, a veterinarian has been named director of the famous Botanic Gardens in Buitenzorg.

This is not scientific direction but political control, which nowhere in the world has produced scientifically significant results. Is it not time for us scientists to act and prevent renewal of methods which were so disastrous in Germany? It has been suggested that the scientific institutions in the Netherlands East Indies be brought under the supervision and control of UNESCO, which would insure continuation of the high standards maintained in the decades before the Japanese invasion. An expression of opinion in this matter, directed toward our representatives on UNESCO, might give results. (F. W. WENT, *California Institute of Technology, Pasadena.*)

In the spring of 1946 I observed that many wild plants of *Cornus florida* in the vicinity of Ann Arbor, Michigan, which I remembered as having borne pure white blossoms formerly, now produced pink flowers. The pink tint usually was uniform over any one plant, but it ranged from the slightest blush to a deep pink from plant to plant. None was seen which was quite as deeply colored as the red variety of *Cornus florida*, but some were near it.

In the present season all these plants again formed white flowers, making it apparent that the weather of the spring of 1946, one of the driest on record for the region, was responsible for the change of color. Although I have no record of it, the amount of sunshine must have been much greater than usual. The combination of much light and little water may have caused a great increase in anthocyanin formation paralleling the familiar *firing* of the lower leaves of corn in hot, dry weather. (CARL D. LA RUE, *Department of Botany, University of Michigan.*)

Folliculinids are complex ciliated protozoans, very similar to the better-known stentors. The stentors are found chiefly in fresh water; the folliculinids, mainly in marine and brackish water, although some have been recorded from fresh water in England, France, Switzerland, Canada, and Uruguay. Since they occur in so many remote points in all oceans, it is easy to assume that they will yet be found along the coasts of all lands.

That they occur in India was stated in 1916, but this publication was so deeply buried in accounts of other animals that it has only recently been exhumed by H. Shrinivasa Rao, Deputy Fisheries Adviser to the Government of India, who communicated the facts to me.

Folliculinids fasten their dwellings to all sorts of inanimate and animate objects. Some seem to have uncanny ability to search out concealed places and may establish their dwellings within those abandoned by other small animals. Some locate on the outside of hydroids, and it is in association with the latter that they have been found in India.

Many small jellyfish that swim free in the ocean separated themselves from hydroids, like plants branching, and firmly fixed to objects of the ocean floor. Among these the genera called *Tima*, *Eirene*, and *Phortis* are much alike, and even specialists have not agreed as to which name to use. MacCrady, the pioneer student of jellyfish in America, described a species of *Phortis* from Charleston, South Carolina, and W. K. Brooks, in his studies of jellyfish of Beaufort, North Carolina, was able, in 1883, to rear the hydroid phase from this same rare jellyfish.

Another species of *Phortis* shines with exceptionally strong blue-green phosphorescence. In 1905 Browne took from the sea off Ceylon a jellyfish he named *Eirene ceylonensis;* however, Mayer, in his *Jellyfish of the world*, decided that this was really a *Phortis*—a conclusion also reached by N. Annandale when in 1915, as superintendent of the Indian Museum, he reared from this jellyfish the little hydroid he had discovered in 1906 and identified as *Campanulina*. The same sort of jellyfish taken from the sea off Ceylon by Browne suddenly appeared in great numbers in July 1915, more than 1,000 miles away, in a brackish canal near Calcutta, in the delta of the Ganges. The canal water had a salinity of but 1.0085, reduced to 15°C. In this canal, "far removed from the sea though connected at one point with the tidal waters of the Hooghly," the jellyfish were no longer found in September, when the monsoon rains probably further diluted the brackish water. From these little jelly-fish less than an inch in diameter were reared the *Campanulina* hydroids, scarcely visible to the naked eye. In this study the work of Annandale was continued by R. E. Lloyd, professor of biology at the Medical College, Bengal, and their combined results were published under the title "Hydrozoon *Campanulina ceylonensis* (Browne)" (*Rec. Ind. Museum, Calcutta*, 1916, 12, 49–57). We quote from Lloyd's detailed account the following sentence—sole evidence of the occurrence of folliculinids in India: "The hydroid first found at Port Canning was living in association with the protozoan *Folliculina* and this organism also occurred among the colonies taken from the canal."

Dr. Rao's search in the collections of the Indian Museum revealed nothing in the way of slides or material bearing upon these folliculinids. Apparently Prof. Lloyd did not identify the species of folliculinid he observed, but as to Lloyd's identification of the group Dr. Rao writes that he has "no reason to doubt his identification of the infusorians he found on the hydroids of Port Canning."

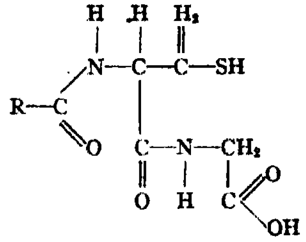
It is possible that other casual references to the occurrence of folliculinids in some corner of the world may remain hidden in the vast literature. Should anyone discover such hidden records, I would greatly appreciate being guided to them. (E. A. ANDREWS, *The Johns Hopkins University, Baltimore, Maryland.*)

The differentiation of the pathogenic species of *Sporotrichum* has always presented difficulties. It has been known since 1915 that carbohydrate fermentations, pigment formation, and production of chlamydospores are variable factors and cannot be used for the identification of species. In fact, the tendency among mycologists today is to regard the *Sporotrichum* pathogenic to man as one species.

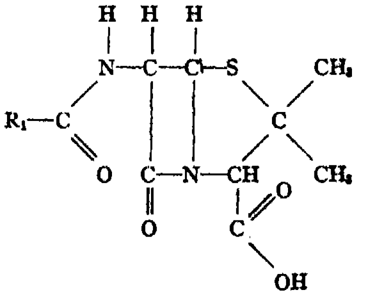
Sixteen strains of *Sporotrichum* representing examples of *S. schenckii*, *S. beurmanni*, *S. asteroides*, and *Rhinocladium equinum*, originating in America, Europe, and South Africa, were studied. Extensive agglutination and absorption experiments showed that these *Sporotricha* all have a common antigenic factor.

Details of this work are being published elsewhere. (H. I. LURIE, *South African Institute for Medical Research, Johannesburg.*)

With reference to the interesting discussion between C. S. Leonard (*Science*, November 29, 1946, pp. 501–502) and C. J. Cavallito (*Science*, February 28, pp. 235–236) about the mode of action of penicillin, I should like to call attention to an interesting circumstance which I did not find mentioned in the literature available to me, *i.e.* the remarkable structural resemblance between penicillin and glutathione. In fact, the thiazolidine ring of penicillin may be imagined as resulting from a double ring closure between the β-methyl group of cysteine and the amino group of glycine on one side and between the SH group of cysteine and the α-methyl group of glycine linked together by a (dimethyl)-methyl radical on the other side (Fig. 1).



Glutathione



Penicillin

FIG. 1

From this point of view the terminal groups of penicillin would be characterized by a double ring formed between certain members of the open chains of the cysteyl-glycine radical through the intervention of a dimethyl methane, which would blockade irreversibly the SH group of cysteine. The glutamyl radical of glutathione is replaced with different other acyl radicals in the different classes of penicillin (pentanoyl, heptanoyl, valeryl, phenylacetyl, etc.).

It would be too far-reaching to draw without experimental basis any conclusion from this circumstance, but one may think of the possibility of penicillin competing with glutathione for enzymatic or other mechanisms important for microbial reproduction. (E. FISCHER, *Experimental Laboratory, S. A. Organa, Santiago, Chile.*)

TECHNICAL PAPERS

Inhibitory Effects of Ethyl Carbamate on Prostatic Cancer[1]

CHARLES HUGGINS, SUNG TING YÜ, and RALPH JONES, JR.

Department of Surgery, University of Chicago

The antiandrogenic treatment (*7*) of human prostatic cancer is not completely satisfactory, since remission of the disease was less than 5 years in duration in 80 per cent of the cases (*6*) so treated. We have investigated many possible chemotherapeutic agents in patients in whom relapse has occurred after endocrine control, but have encountered only one effective agent in ameliorating the disease when it has become androgen independent and wide spread—ethyl carbamate. Prostatic cancer may be studied simply by enzymatic methods, since the phosphatases of serum constitute sensitive and objective indices of neoplastic activity.

Warburg (*12*) showed that phenyl urethane in small amount caused an arrest of mitosis and cell division in fertilized eggs of the sea urchin with only small change in oxidation in the cells, while a concentration of 0.002N reduced oxygen consumption about one-half. Ethyl carbamate (*4*) nearly abolished mitosis in the cornea of the rat for brief periods. The present interest in urethane in tumors arose through the work of Haddow and his associates; ethyl and isopropyl phenyl carbamates (*5*) were found to cause a temporary but significant retardation of growth of spontaneous mammary cancer in the mouse and in the Walker carcinoma 256 of rats; in the latter tumor, ethyl carbamate also had an inhibitory effect. Paterson and co-workers (*10*) discovered that ethyl carbamate had a very great palliative effect in human leukemia; there was also some regression in 3 of 13 cases of mammary cancer. Ethyl carbamate in doses of 0.1–1 mg./gram caused a decrease in the leucocyte count in myelogenous leukemia (*2*) in the mouse. Goodman and Lewis (*3*) observed that this agent caused regression of cutaneous metastases of a highly anaplastic carcinoma in one patient; the primary site of the tumor was unknown. We wish to present four observations which prove an effect of ethyl carbamate on prostatic cancer and which deal with its mode of action.

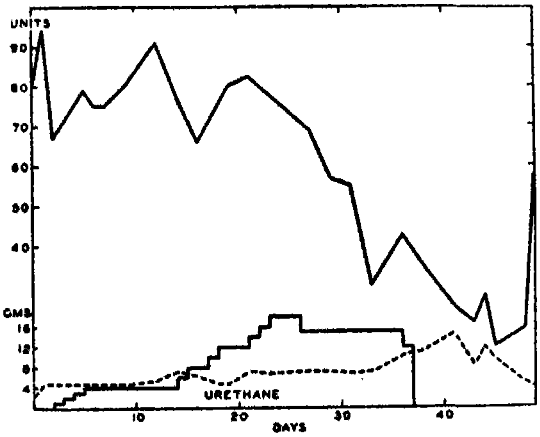


FIG. 1. Changes in acid phosphatase (————) and alkaline phosphatase (---------) of serum induced by toxic amounts of urethane.

(1) *Ethyl carbamate is a toxic drug which causes inhibition of some cases of prostatic cancer.* In one patient an average daily dose of 9 grams of ethyl carbamate was administered for 33 days with fatal effect. At first there was improvement, with a regression in the size of the prostate, return of sensation in a saddle area of anesthesia due to metastatic involvement of the cauda equina, and a decrease of the acid phosphatase level (Fig. 1) of the blood from 90 to 10 King and Armstrong (*9*) units; however, 6 days after discontinuing the medication, icterus and other evidence of liver damage became evident, and the patient died 6 days later from hepatic necrosis, there being a terminal rise of acid phosphatase. In three patients with wide-spread cancer of the prostate there has been a considerable regression of the primary tumor, relief of pain, an improved sense of well-being, and a significant decrease of the acid phosphatase of the serum (Fig. 2).

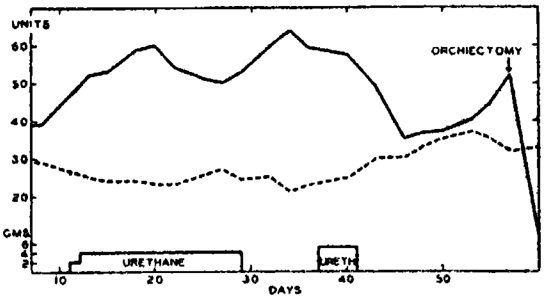


FIG. 2. Decrease in acid phosphatase (————) of serum induced by urethane administration and later by orchiectomy in man. The reciprocal changes in alkaline phosphatase (---------) are indicated.

Effects on the tumor are demonstrable with smaller doses of ethyl carbamate than are required to cause profound changes in the acid phosphatase level where the dosage required approaches the toxic amount. A patient who had an advancing prostatic cancer following a remission induced by orchiectomy, estrogen administration, and roentgenotherapy was found to be bedridden with a large indurated primary tumor and multiple osseous metastasis; 4 grams of ethyl carbamate daily for 5 days, followed by a maintenance dose of 1 gram daily for 6 weeks, eliminated pain and caused great decreases in the size and hardness of the tumor.

Ethyl carbamate must be administered with great caution, and the leucocyte count of the blood determined frequently. It is not considered safe to continue ethyl carbamate when the leucocyte content is less than 4,000/mm.^{3} or when nausea and vomiting occur.

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[1] Aided by grants from the Albert and Mary Lasker Foundation, Inc., the Sidney and Frances Brody Foundation, Mr. Ben May, and the Committee for Research in Problems of Sex, National Research Council.

(2) *The favorable effects of ethyl carbamate are not due to antiandrogenic action.* The prostatic isolation operation (*8*) was done, and the prostatic secretion collected at 2-day intervals in 3 castrate dogs which received both testosterone propionate (10 mg.) and urethane (4–8 grams) daily for 31 days; the amount of the prostatic secretion increased steadily, proving that the effects of androgen on the prostatic cells were not eliminated.

(3) *Ethyl carbamate does not inhibit glycolysis.* It is well known that tumors are characterized by a high rate of aerobic and anaerobic glycolysis. We have found that urethane in concentrations up to 0.005M had no demonstrable effect on the rate of anaerobic glycolysis in cell-free brain extracts supplemented with glucose and the system described by Utter, Wood, and Reiner (*11*). Lactic acid production was measured manometrically (Table 1). It was concluded that urethane did not inhibit the rate-determining reaction of glycolysis in this particular cell-free system.

TABLE 1

EFFECT OF ETHYL CARBAMATE ON ANAEROBIC GLYCOLYSIS IN RAT BRAIN EXTRACT*

Exp.	Controls	With ethyl carbamate (0.005M)
1	99	107
	106	103
2	100	87
	87	95
3	102	100
	93	95
	104	104

* Results are expressed in microliters of CO_2 liberated in one hour corresponding to lactic acid produced.

Method of Utter, Wood, and Reiner (*11*). The main compartment of the Warburg vessel contained: adenosine triphosphate, 0.0007M; diphosphopyridine nucleotide, 0.0005M; magnesium phosphate, 0.008M; sodium bicarbonate, 0.048M; nicotinamide, 0.04M; phosphate buffer, pH 7.4, 0.01M; 0.05ml. of rat brain extract; and either 0.005M ethyl carbamate or water. The side-arm flask contained glucose and hexose diphosphate to make the final concentration 0.028M and 0.0025M, respectively, in the complete system; final volume, 1 ml.

(4) *Ethyl carbamate has a suppressive effect on the transplantable Sarcoma 39 of rats.* This polymorphous cell sarcoma of albino rats has a 50–90 per cent incidence of takes in our laboratory. The tumor was inoculated subcutaneously in 26 rats, and ethyl carbamate (0.5–1 mg./gm.) was injected daily for 7 days and then at 2-day intervals for 14 days; as a control, 21 rats were inoculated but not injected with urethane. None of the experimental group developed neoplasms, while 12 of the controls grew large tumors. One week after cessation of urethane, 2 of the urethane group developed tumors. Since the dosage of urethane induced anesthesia and weight loss, a further group of controls was established to eliminate the adverse effect of malnutrition on the tumor. Eight rats were inoculated with this tumor and maintained on complete food starvation for 14 days; 4 rats developed tumors on the 9th to the 13th day of starvation.

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Hexokinase Activity and Diabetes Mellitus

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The observations of Price, Cori, and Colowick (*1*) that muscle and liver hexokinase are inhibited, *in vitro* by certain fractions of the anterior pituitary gland and that this inhibition is prevented by the addition of insulin seemed to provide the explanation of the mechanism whereby "diabetogenic" extracts of this gland produce diabetes in susceptible animals. The subsequent observation that a decrease in the hexokinase activity of the muscles and liver occurs in the alloxanized rat (*2*) seemed to imply support to the concept that diabetes is associated with an increase in anterior pituitary activity. During an investigation of the action of various tissue extracts on the activity of muscle and liver hexokinase, we have made observations which question the validity of such a concept.

Hexokinase-containing extracts were prepared according to directions generously furnished us by Colowick (personal communication) and their activity assayed both by the manometric estimation of CO_2 production and by direct analysis of the transfer of easily hydrolyzable phosphate.

The extracts displayed considerable hexokinase activity by either manometric or chemical criteria. In confirmation of the results of Price, Cori, and Colowick, it was possible on occasion to demonstrate the inhibition of such activity after addition of the diabetogenic extracts of pituitary and, further to note the reversal of this inhibition after addition of insulin. Of more than passing interest, however, was the inconstancy of the inhibitory activity of the anterior pituitary extracts. Many apparently identical preparations, known to contain potent diabetogenic factors, failed to produce any inhibition of hexokinase activity (Table 1).

Inasmuch as some anterior pituitary extracts known to possess "diabetogenic" activity may fail to inhibit hexokinase activity (in crude extracts) while other extracts, prepared in an identical manner, may suppress this activity, it is possible that the anterior pituitary gland may contain an hexokinase-inhibiting factor quite distinct from its "diabetogenic" factor and that the inconstancy of the demonstration of the inhibiting factor may be a consequence of its extreme lability or poor extraction.

TABLE 1

EFFECT OF "DIABETOGENIC" PITUITARY AND SPLENIC EXTRACTS ON RAT MUSCLE HEXOKINASE ACTIVITY*

Expt.	Effect of pituitary	CO_2 produced (mm.³)	Expt.	Effect of spleen	CO_2 produced (mm.³)
	Extract alone	53		Extract alone	54
1	Extract + APE	8		Extract + 0.4 ml. spleen	35
	Extract + APE + insulin	56		Extract + 0.4 ml. spleen + insulin	57
	Extract alone	48	3	Extract + 0.2 ml. spleen	46
2	Extract + APE	50		Extract + 0.2 ml. spleen + insulin	53
	Extract + APE + insulin	50		Extract + 0.1 ml. spleen	49
				Extract + 0.1 ml. spleen + insulin	53

* The hexokinase activity of the muscle extracts was measured manometrically. The APE was prepared according to Young (*3*). The splenic extracts consisted of 1 part spleen + 4 vols. water homogenized in a Waring blendor, adjusted to pH 4, filtered, and the filtrate adjusted to pH 7.5. Insulin was added to a final concentration of 400 γ/ml. Figures give gas production for a 45-minute period of incubation.

Since the results of Price, *et al.* were obtained with fractions of pituitary quite different from those used in the above experiments our data are not to be construed as a lack of confirmation of their results. They do indicate, however, that a tissue fraction quite distinct from the "diabetogenic" hormone may be responsible for the inhibition of hexokinase activity. That the presence of factors responsible for hexokinase inhibition may not be uniquely confined to the pituitary has been suggested by our observations (Table 1) that splenic extracts actively inhibit hexokinase and that the degree of inhibition is proportional to the amount of splenic extract added. In contrast to the experience of Price, *et al.* with anterior pituitary extracts, the amount of inhibition produced by splenic extracts has been relatively small, due perhaps to their lack of concentration. Whereas splenic extracts almost invariably produce significant inhibition, by manometric criteria, the degree of reversal of this inhibition *in vitro* by added insulin has been most inconstant, varying from no increase in activity to complete restoration. The significance of these observations and the nature of the inhibiting factor are being investigated.

TABLE 2

EFFECT OF INSULIN ON HEXOKINASE EXTRACTS FROM MUSCLES OF ALLOXANIZED AND NORMAL RATS*

Type of extract	CO_2 produced (mm.³)	Micrograms phosphorus/ml. reaction mixture			
		Before incubation		After incubation	
		P_0	P_7	P_0	P_7
"Alloxanized" extract alone	60	112	161	109	123
Extract + insulin	59	112	158	111	124
"Normal" extract alone	43	87	147	92	118
Extract + insulin	39	87	147	93	117

* Muscle extracts were prepared and their hexokinase activity measured manometrically and chemically. The blood sugar of the alloxanized rat was 415 mg. per cent. Results were obtained after a 45-minute incubation. Insulin was added to a final concentration of 400 γ/ml .

In view of the preceding, we found it pertinent to test the postulate that there is a decrease in the activity of the hexokinase preparations obtained from the muscles and liver of alloxanized rats and that the addition of insulin *in vitro* will cause an increase in the range of normal activities. Rats were rendered diabetic by the administration of alloxan, and extracts of muscles from such rats were prepared as above and used immediately. In all instances, such extracts displayed an hexokinase activity comparable with that found in extracts of normal rat muscles. Further, the addition of insulin failed to increase the activity of either "normal" or "diabetic" extracts (Table 2).

Since our alloxanized rats exhibited a marked hyperglycemia and glycosuria, while the extracts from such rats gave no evidence of a depression of hexokinase activity, it would appear that the disorders of glucose metabolism encountered in diabetes do not necessarily result from any inhibition of hexokinase activity.

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Antares (α Scorpii)

OTTO STRUVE

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The night of July 2–3 was exceptionally fine at the McDonald Observatory, on Mount Locke, in western Texas. The sky was perfectly clear, and the apparent "tremor-discs" of the stars, as seen in the 82 inch reflecting telescope were unusually small. These conditions made it possible for me to carry out an experiment which I had started in the summer of 1940 (*1*), but for the completion of which conditions—atmospheric as well as instrumental—were never sufficiently favorable during the intervening years.

Antares (α Scorpii) is a visual double star, consisting of a first-magnitude, red supergiant and a sixth-magnitude, blue, underluminous helium star. The separation between the two stellar components is 3″ (seconds of arc). Ten years ago O. C. Wilson and R. F. Sanford (*2*) found, at the Mount Wilson Observatory, that the spectrum of the faint blue companion of Antares contains emission lines which correspond to low-level forbidden transitions of ionized iron, [Fe II]. These lines were first identified by Merrill in the spectrum of η Carinae, soon after the solution of the problem of the nebular forbidden radiations by Bowen.

The purpose of my work at the McDonald Observatory was to find the source of the forbidden iron lines in the spectrum of the companion of Antares. Good "seeing" conditions were required in order to separate the light of the very luminous red star from that of the faint blue star. I at first turned the large stellar slit-spectrograph (attached below the

Cassegrain focus of the 82-inch telescope) until the slit was at right angles to the line joining the two stars. An exposure of 26 minutes, during which the faint star was kept trailing along 2 mm. of slit length, produced the usual widened spectrum of the helium star, with the lines of [Fe II] in emission superposed over the continuous spectrum. Next, an exposure of 5 minutes, with the star held stationary on the same place upon the slit produced a heavily overexposed continuous spectrum of the star, 0.18 mm. in width, which corresponds to 2.6″ (seconds of arc). This width is due partly to the tremor-disc of the star and partly to photographic overexposure. The forbidden iron lines, expecially λ4287.41, extend on both sides of the star's continuous spectrum, like two little black arrows, to a distance of 0.074 mm., or 1.1″. The appearance of these arrow-like extensions is very much like that of the hydrogen lines in W. W. Campbell's famous "hydrogen-envelope star," and the explanation of the phenomenon is doubtless the same: the [Fe II] emission lines originate in a small nebulosity surrounding the blue companion of Antares.

But before we can be entirely certain we must convince ourselves that the extensions of the emission lines are not a photographic effect. Perhaps the star image was not as tranquil on the slit as I thought, so that underexposed edges on both sides of the heavily exposed strip might leave the continuous star spectrum invisible, though the bright lines would show upon development. To test this I obtained, under similar conditions, with the star-image fixed upon the slit, exposures of 5, 15, and 45 seconds. If the "spilled-over-the-edge" star light had caused the emission lines on the 5-minute exposure, then these short exposures should give the emission lines an opportunity for appearing in the central strip, where the continuous spectrum had appeared on the longer exposure. In reality, the 5-second exposure shows only the barest trace of continuous spectrum; the 45-second exposure shows it plainly. But not one of the three shows even a trace of the [Fe II] lines. The light of the helium star itself does not contain forbidden iron. The emission lines come only from a small nebulosity, about 5″ (seconds of arc) in diameter, which surrounds the helium star.

Next, I turned the spectrograph until the slit was along the line joining the two stars. With two exposures, of 1 and 3 minutes, I could separate completely the two star spectra. The [Fe II] lines again appear as faint extensions on both sides of the helium star. They are not strengthened in the space between the two stars, and, if anything, they suggest that the nebulosity may be slightly elongated in a direction at right angles to the line joining the two stars.

The nebulosity is enormously large in linear measure. The bright red primary star is one of the few whose diameters have been measured by Pease with the Mount Wilson interferometer. It is 0″.040, or 450 times the diameter of the sun. The nebulosity is about 150 times larger, which would make it 50,000 times larger than the sun. The diameter of the helium star has not been measured, but it can be inferred from the temperature and distance to be roughly one or two times the diameter of the sun. Near the outer boundary of the nebulosity the density of the helium star's radiation is weakened by a factor of the order of 10^{-9}, as compared to the density of radiation within its atmosphere proper. Very roughly, we may say that the nebulosity is about 10 times larger, in diameter, than the solar system.

Despite the fact that from a representative point within the nebula the red star appears as a disc which is about 200 times larger than the blue star, it is the light of the latter—in the ultraviolet region—which is responsible for the ionization of the gases, though not necessarily for the excitation to low-lying atomic levels.

A very strange result of observation is the absence of any other emission lines than [Fe II]. That the permitted Fe II lines are not photographed was explained some years ago by Swings and me as a consequence of what may be described as a fictitiously low excitation temperature. But why are the lines of hydrogen absent? Normally, we observe them with great strength in nebulae, in the interstellar gas, and in almost all star spectra. If they are absent in the nebulosity of Antares, we immediately try to infer that there is too little ionization for recombinations to take place. But since we observe no Fe I (or any other atoms of low ionization potential) in the nebula, we must have a majority of the iron atoms once ionized. The potential is 7.8 volts. Then, if we apply this to hydrogen, with 13.5 volts, we find that approximately 1 out of 10 hydrogen atoms is ionized and therefore capable of producing an emission spectrum by recombination. The usual cosmical abundance of hydrogen is perhaps 10^4 times greater than that of iron. Hence, there would be all reason to expect the Balmer lines to appear strong in emission (as, in fact, they do in ordinary gaseous nebulae).

It seems to me that the absence of H suggests a real—not only an apparent—paucity of hydrogen in the nebula of Antares. How can we explain this?[1] An attractive idea is to suppose that the nebulosity[2] is not strictly gaseous but that it consists of solid, perhaps even meteoric, particles which have long ago lost most of their hydrogen and are rich in iron. We certainly have such a nebulosity in the solar system, where it leads to the phenomenon of the solar corona on one side and to that of the zodiacal light on the other. We observe emission lines in the corona, but not in the zodiacal light. But that may be due to the relative weakness of the solar radiation in ultraviolet wave lengths. What I am suggesting here is that the [Fe II] radiations in Antares are, in a sense, a counterpart to what in the solar system we know as comet radiations. This hypothesis would explain not only the absence of H but also the very strange dependence upon excitation potential[3] which Swings and I observed in the intensities of permitted Fe II in other, similar objects (WY Geminorum, Boss 1985, etc.).

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[1] We might think of the atmosphere of the earth, which is also poor in H, but which shows, in the spectrum of the night sky, strong forbidden lines of oxygen, [O I]. Since these lines are absent in Antares, as are also the lines of [O II], we must look for a source which is not only depleted in hydrogen (as is the atmosphere of the earth) but also in oxygen and nitrogen—that is, in all light elements.

[2] Astronomers will recall that in 1936 we found a large reddish nebulosity around Antares which shines by reflected light from the red supergiant. This reflection nebula (*Astrophys. J.*, 1936, 84, 219) is vastly larger than the nebula considered here. There may be no connection between the two, although the large reflection nebula also consists of solid interstellar particles.

[3] An interesting and perhaps significant feature is the great strength, on my recent spectrograms, of [Fe II] 4287, as compared with [Fe II] 4244. They belong to different multiplets.

IN THE LABORATORY

An Instrument for Plotting ED_{50} Curves

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Several methods for plotting ED_{50} curves have been described. De Beer (*2*) employed a permanent board with several instruments which enabled him to plot the curve and compute the results accurately and rapidly. Litchfield and Fertig (*3*) have described a rapid and accurate method for the calculation of the ED_{50} value, as have Miller and Tainter (*4*), who employed a special probit paper. Many investigators have used all of these methods, but thus far no instrument has been described which would allow a choice of the method to be used. The instrument described below has been used in our laboratories for over a year and has given accurate results with any of the above methods as well as with the longer Bliss (*1*) method.

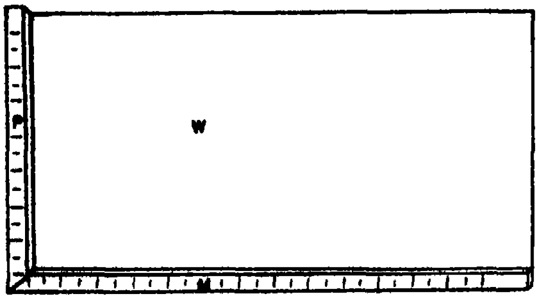

FIG. 1. Completed instruments. P = probit or per cent response scale; M = millimeter graph paper scale; W = Winthrop Probit Paper on plywood base.

The instrument (Fig. 1) was constructed from a piece of plywood 15 x 12 x ¾ inches, bordered by two pieces of molding 1 x ¾ x 15 inches and 12 inches respectively. To the plywood was glued a piece of Winthrop Probit Paper.[1] To the left-hand molding was attached the two scales cut from another piece of the same paper. While being glued, these scales were aligned so that part of the scale extended over the inner edge of the molding and fitted flush with the plywood. Attached to the lower molding was a piece of millimeter graph paper, which was divided into an arbitary scale allowing the plotting of log doses to 3 or more places, depending upon the accuracy desired. The entire board, including scales, was painted with a solution of cellulose nitrate in acetone to protect it against wear.

For plotting the ED_{50} of estrogenic response, where there is a definite logarithmic ratio between each dose, the scales on the plywood are used. The board is covered with a piece of tracing paper, and each dose response is marked off. The provisional and corrected curves relating log dose to probit or per cent response are obtained in the conventional manner, depending upon the method used. In plotting LD_{50} data, the scales on the plywood base of the board are covered with a piece of blank paper, the scales on the molding being used to obtain the dose-response curve. The log-dose values on the horizontal scale are chosen so that the greatest spread between doses will be obtained. This has a tendency to flatten the curve and make the results more accurate. The calculations for the provisional and corrected curves are done in the manner described by the method used.

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[1] Obtained from the Winthrop Chemical Company, Rensselaer, New York.

Conversion of Heart Potentials Into Auditory Equivalents

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For purposes of our research, it became desirable to have an instrument that would convert to auditory equivalents the changes in electrical potential occurring during the cardiac cycle. In consulting the literature, we found many instruments that involve the simple electronic amplification of the heart sounds (which may then be recorded graphically or phonographically) or the graphic or oscillographic recording of the changes in heart potential: amplifying stethoscopes, recording stethoscopes, stethographs, and electrocardiographs; but we were unable to find what we have termed an electrocardiophone or EKP: an instrument that, instead of expressing the heart potentials in graphic form, expresses them in auditory equivalents.

In developing a frequency modulation amplifier suitable for our purposes, preliminary difficulties were met in handling the extremely low frequencies without distortion. These difficulties have been largely overcome, although alternating-current fields and similar electrical conditions must be avoided.

The basic circuit of the electrocardiophone utilizes the fact that two radio frequencies will produce a beat frequency when fed into a suitable detector circuit. Since the beat frequency is equal to the difference between the frequency of oscillator I and oscillator II, it will be an audible frequency if the oscillators are within a few kilocycles of each other.

Oscillator II (Fig. 1) is adjusted to produce an audible beat note suitable to the operator. The frequency of oscillator I is changed by the reactance tube modulator in accordance with the changes in heart potential, which are amplified by the low-frequency amplifier to a level necessary to actuate the reactance tube modulator.

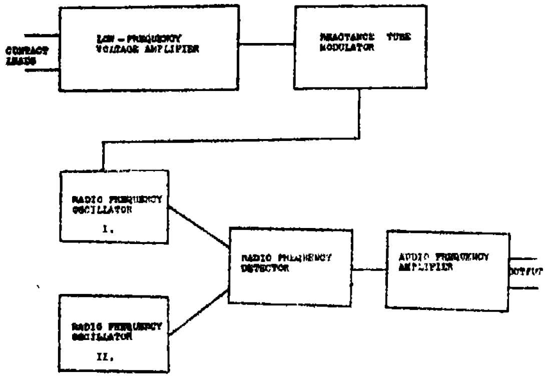
CONTACT LEADS
LOW – FREQUENCY VOLTAGE AMPLIFIER
REACTANCE TUBE MODULATOR
RADIO FREQUENCY OSCILLATOR I.
RADIO FREQUENCY DETECTOR
AUDIO FREQUENCY AMPLIFIER
OUTPUT
RADIO FREQUENCY OSCILLATOR II.

FIG. 1

The output of the detector is also amplified. Although a loud-speaker may be used, we have employed a button earphone so arranged (Fig. 2) that the sounds are conducted by rubber tubing into a standard stethoscope equipped with the conventional chestpiece. The auditory equivalents of the electrical potential changes may thus be cut into the normal stethoscopic sounds, which are not amplified or otherwise distorted. Although no attempt has been made to standardize on any given audio frequency, it is obvious that the heart can "play its piece" on any audible range of frequency—often with interesting effects.

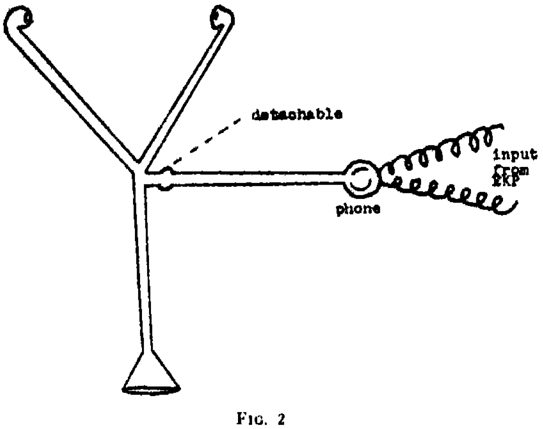

FIG. 2

Correlation of the electrical potential sounds with stethoscopic sounds in health and disease is now being attempted. Further correlation with the electrocardiogram will be tried by the use of a cathode-ray oscilloscope parallel with the electrocardiophone. Sound recordings of both the auditory equivalents of the electrical potential changes and the stethoscopic sounds will permit a more careful dissection of the interrelationship between the heart beat and the potential changes.

The technic should be distinguished from the simple amplification of the changes in heart potential *per se*: these changes are heard only as a clicking sound. For teaching purposes it is held undesirable to use electronic stethoscopic amplification since the resulting sounds depart in quality from those heard with the clinical stethoscope. Since the electrocardiophone utilizes a virgin medium, there is no such conflict here.

The technological details of the apparatus will be published elsewhere.

Simple Formulas for Calculating Percentage Potency in Three- and Four-Dose Assay Procedures

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In many instances in which the log dose-response curves of unknown and standard substances are parallel straight lines simple formulas for the rapid calculation of the percentage potency of the unknown in terms of the standard are helpful However, in order to make use of such formulas, it is essential that the assay be so designed that the unknown and standard materials are treated uniformly, *i.e.* the geometric relationship between the individual doses or concentrations of the unknown and standard must be identical, the same diluent must be employed for each, an equal number of dose or concentration levels of each reactant must be used, and the number of replicates per level of each dose must be uniform. Though the actual number of replicates is immaterial to the application of the formulas presented in this paper, it is recommended that, for accuracy's sake, three or four be employed. Moreover, since the formulas in their simplest expression give no indication of the error of an assay, it is suggested that the individual worker determine (a) the limits of accuracy within which the log dose-response is linear and (b) the precision of his proposed assay, so that he is assured of the applicability of these shortcuts.

Formulas for calculating the potency are available when two similarly related doses of standard and unknown are utilized in assay procedures (*5*). The writer is not aware of any such simple formulas for the calculation of the activity in so-called three- or four-dose assay techniques. The desirability of employing more than two logarithmically related doses is apparent if one makes use of graphic representations of data. Obviously, a straight line is the only curve which can be drawn from the data available when only two doses each of standard and unknown are employed. If three or four doses are used, deviations in the linearity of the log dose-response curve become apparent. Moreover, the supplementary data obtained at additional dose levels with little extra work permits the determination of the individual regression lines or, in the case of the four-dose assay, the omission of data at the highest or lowest dose level of the unknown if such data lie outside the limits of linearity of the dose-response curve.

During the development of a thin filter paper disc-agar plate method for the assay of amylases in which the initial concentration of the standard and unknown enzyme extracts was 1 per cent and the three succeeding doses of each were decreased in a 1:5 ratio, a simple formula for calculating the percentage potency of so-called four-dose assays was developed. This formula, which has universal applicability to four-dose assays under the restrictions given, may be expressed in its simplest form as follows:

$$\%\ \text{Potency} = \text{Antilog}\left[2 \pm c + 5d\,\frac{(U_1 + U_2 + U_3 + U_4) - (S_1 + S_2 + S_3 + S_4)}{[3(U_4 + S_4) + (U_3 + S_3)] - [3(U_1 + S_1) + (U_2 + S_2)]}\right]^1.$$

In this formula, 2 = log 100, the factor for converting the ratio obtained to per cent potency; c = the positive expression of the log ratio between the corresponding doses, *i.e.* U_4 and S_4, of the unknown and standard. (In the formula, the sign of c is positive if the initial dose of the standard was greater, and, conversely, is negative if the initial dose of the standard was smaller, than that of the unknown); 5 = the constant for the four-dose assay; d = the logarithm of the successive dose intervals of both the standard and the unknown; and U_1, U_2, U_3, U_4, S_1, S_2, S_3, and S_4 = the sums of the individual responses of the unknown and standard, respectively, for each dose level, grading from the lowest to the highest.

In a similar manner, a formula was developed which is universally applicable to three-dose assays performed under the same restricted design. This formula in its broadest, but simplest, expression is as follows:

$$\%\ \text{Potency of unknown} = \text{Antilog}\left[2 \pm c + \tfrac{2}{3}d\,\frac{(U_1 + U_2 + U_3) - (S_1 + S_2 + S_3)}{(U_3 + S_3) - (U_1 + S_1)}\right].$$

The terms in this equation have the same meaning as those in the four-dose assay, with the exception that the constant for the three-dose assay is $\frac{2}{3}$ instead of 5.

These formulas, under the restrictions of the test, have universal applicability to any assay in which the log dose-response curve has been shown to be a straight line and the curves of the unknown and standard are parallel. Graphs of the sums of the response at each dose level of both the standard and the unknown reactants give evidence of the parallism of their dose-response curves. If parallelism is not evident, the analysis of variance (*2*), factorial analysis (*3*), and the determination of lambda (*1*) may be necessary to interpret the significance of the assay. Any person familar with factorial analysis will recognize the numerators of the fractions given as the sum of the products dealing with the difference between samples, and the denominators as the sum of the products dealing with the slope of the dosage-response curve, *i.e.* S(xYp), which were given by Bliss and Marks in their factorial scheme for three- and four-dose assays (*3*). The application of the formulas presented here is, however, simpler than that of the potency formula given by these authors, *i.e.* $M = \frac{kID}{B}$. Moreover, both types of formulas give the same potency.[2]

These formulas have been applied in the Wellcome Laboratories to such widely divergent types of assay as agar diffusion methods for determining the potency of antibiotics or of amylases, turbidimetric procedures of assaying for a pneumococcus growth factor, and the mouse squeak test for the assay of analgesics. In the opinion of the author, a four-dose assay is preferable, since it permits the omission of the data from a single dose level (whether high or low), if the limit of linearity of the dose-response curve has been exceeded with the unknown. Hence, calculation of the potency on the basis of the three remaining dose levels may be made by applying the formula for the three-dose assay.

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[1] The formula is derived in the following manner from the original Gaddum formula (*4*), *i.e.*

$$\text{log ratio of potencies} = \frac{\bar{y}_U - \bar{y}_S}{b} - (\bar{x}_U - \bar{x}_S),$$

where $\bar{y}_U$ = mean response of the unknown, $\bar{y}_s$ = mean response of the standard, b = combined slope of the dosage-response curves of the unknown and standard preparations, $\bar{x}_U$ = mean log dose of the unknown, and $\bar{x}_S$ = mean log dose of the standard. But the mean response of the unknown = $\frac{(U_1 + U_2 + U_3 + U_4)}{4N}$, where 4 = the number of doses, N = the number of replicates per dose, and U_1, U_2, U_3, and U_4 represent the sums of the replicates for each successive dose grading from the lowest to the highest; similarly, the mean response of the standard is $\frac{(S_1 + S_2 + S_3 + S_4)}{4N}$. Moreover, where X = the individual polynomial coefficients of the linear term and d = log dose interval, the slope of the unknown, *i.e.* $b = \frac{2S(xYp)}{dNS(X^2)}$ becomes $\frac{2(3U_4 + U_3 - U_2 - 3U_1)}{dNS(X^2)}$ and that of the standard,

$$\frac{2(3S_4 + S_3 - S_2 - 3S_1)}{dNS(X^2)}.$$

Hence, the average slope of the unknown and the standard is

$$\tfrac{1}{2}\left[\frac{2(3U_4 + U_3 - U_2 - 3U_1 + 3S_4 + S_3 - S_2 - 3S_1)}{dNS(X^2)}\right].$$

But X^2 = 20 for a four-dose assay. Therefore, by substituting and combining terms, the average slope becomes

$$\frac{[3(U_4 + S_4) + (U_3 + S_3)] - [3(U_1 + S_1) + (U_2 + S_2)]}{20\ dN}.$$

By further substituting in the Gaddum formula, the following result is obtained: the ratio of potency of unknown to standard =

$$\frac{(U_1 + U_2 + U_3 + U_4) - (S_1 + S_2 + S_3 + S_4)}{4N} \cdot \frac{20\ dN}{[3(U_4 + S_4) + (U_3 + S_3)] - [3(U_1 + S_1) + (U_2 + S_2)]}$$

$+ (\bar{x}_S - \bar{x}_U)$; this reduces to the formula in the text, since $c = \bar{x}_S - \bar{x}_U$.

[2] After this paper was in press, it was suggested to the author that, for convenience, the formula for the two-dose assay should be included. In order to make the previous formula analogous to the formulas herein presented the term c has been included, and the terms in its denominator have been rearranged. The revised formula for the potency of the unknown in a two-dose assay procedure is as follows:

$$\%\ \text{Potency} = \text{Antilog}\ 2 \pm c + d\,\frac{(U_2 + U_1) - (S_2 + S_1)}{(U_2 + S_2) - (U_1 + S_1)}$$

Book Reviews

Retinal structure and colour vision: a restatement and an hypothesis. E. N. Willmer. Cambridge, Engl.: at the Univ. Press, 1946. Pp. xii + 231. (Illustrated.) $4.50.

This book is essentially the statement of an hypothesis of color vision. It contains a Foreword, a Preface, seven chapters, and an Addendum. The Foreword, by W. D. Wright, recommends the book with obvious misgivings. The Preface, by the author, tells us that what follows is "frankly provocative and speculative." And so, indeed, it is.

The first chapter is mainly histological description of the retinal elements, including not only the rods and cones, but the neural elements as well. The second chapter, which treats of the functions of the retinal elements, presents information about nerve impulses, dark adaptation, the spectral sensibilities of the rods and cones, and about visual purple and visual violet.

With the third chapter the presentation of the hypothesis begins and is continued through the next three chapters. The seventh chapter deals with color blindness and with the bearing of Willmer's hypothesis on it.

The Addendum, written after the rest of the book was in press, records some recent experiments on color vision of the fovea and further elaborates the hypothesis. It closes with a general statement of the ideas involved. A list of references and two indexes follow.

The essential thesis of this book rests on the fact that only two receptors—rods and cones—can be differentiated histologically in the retina. The author then assumes that color vision depends on the combined action of these two receptors. The rods are mainly concerned with the short-wave or blue and green end of the spectrum; the cones, with the long-wave or yellow and red end of the spectrum. The various color sensations result from the relative stimulation of the two receptor systems by the different parts of the spectrum.

The main quantitative prop for this novel idea comes from manipulation of the spectrum luminosity curves of the rods and cones when these are of equal height or equal area. If for each wave length one plots the cone luminosity as abscissa and the rod luminosity as ordinate, the resulting curve roughly resembles the standard international (ICI) spectrum locus plotted on a right triangle. Some additional assumptions and a logarithmic plot of the cone and rod luminosities for each wave length result in a diagram which vaguely resembles the just discriminable chromaticity step data developed by MacAdam and by Wright for the color domain. A further translation from luminosity to frequency of nerve impulses in rod and cone fibers yields curves which describe in a roughly quantitative way the saturation of the spectrum and the addition of white to spectral colors.

Finally, since one of the central facts of color vision is its trichromatic nature, a third receptor is added to the rods and cones. This is a hypothetical non-dark-adapting day-rod whose properties are not defined too clearly, but whose spectral sensibility may be different from that of ordinary rods. The fovea centralis is described as composed of cones and of these non-adapting day-rods, which makes it dichromatic, as some experiments appear to show.

All this is amusing and speculative, and would have made an interesting afternoon's conversation between the enthusiastic author and a more critical mentor. Presented as a book of over 200 pages, however, the idea becomes labored and unconvincing. Its central thesis rests on a misconception. The rod and cone luminosity curves are usually drawn to equal heights for convenience, not because they are really so. Actually the rod maximum is about 50 times as high as the cone maximum. Moreover, while some observers have a few rods in the fovea, many people show none. Still, color vision is essentially a phenomenon of the fovea.

The audience of this perverse book is a limited one, because only those who are thoroughly familiar with the data of vision in general and of color vision in particular can read it with the necessary critical evaluation. Others will surely become confused, not only because of the strange and incomplete nature of the ideas, but because of the mistakes and misunderstandings, of which there are many.

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Statistical analysis in biology. (2nd ed.) K. Mather. New York: Interscience, 1947. Pp. 267. $5.00.

Because of its clarity, the first edition of this book gained considerable favor among biologists. The revised second edition is changed in no fundamental respect. It includes a new chapter on the angular transformation for proportions and the probit transformation for dosage-response data, written in the same clear style. Other changes involve the addition of footnotes, corrections of typographical errors, and new dating of references.

The book covers the common tests of significance, the normal deviate test, the t-test, the X^2-test, and the analysis of variance F-test, exhibiting their use in a considerable variety of biological experiments. The mathematical models of frequency distributions which arise most often in practice are explained rather thoroughly. These include the binomial, the normal, and the Poisson distributions. Three chapters on two or more variates and a chapter on estimation of unknown parameters complete the volume.

The author has placed emphasis on the advantages of planning experiments in order to extract maximum information from the observations. More emphasis might be placed upon the principles and methods of estimation, carrying the exposition of these methods along with the discussion of tests of significance rather than relegating them to a late chapter. An introduction to the concepts of the power of a statistical test and of errors of the first and second kind in testing statistical hypotheses might not be amiss in a volume of this sort, although an exposition for students in the nonmathematical sciences might present a considerable problem.

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Military Psychology in War and Peace

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WHAT ARE THE CONTINUING PROBlems of military psychology? This is a timely question. It should be faced squarely, in these chaotic days between war and peace, before the cataclysm of World War II has receded too far into the past. Today it is possible to look closely at the varied kinds of professional work done by psychologists—more than 1,300 strong—who wore the uniforms of the armed forces or were employed by them between 1940 and 1946 (*2*). We can thrill with pride at their accomplishments, take note of serious discrepancies between need and fulfillment, and undertake to discern those problems of military psychology which undoubtedly will still be pressing a few years hence.

It should not be assumed that the pattern of warfare 5 years hence, or 50, will closely resemble that of World War II. A third World War will differ quite as much from the second as the second did from the first in magnitude and in the terrific destruction of civilian lives, dwellings, and industries. If it comes, it will be greatly depersonalized—relatively less man-to-man combat, we are told—and there will surely be increasing reliance on highly intricate mechanisms. Any future war, then, is likely to differ greatly from those of the past in scope, intensity, speed, civilian involvement, depersonalization, and mechanization.

In some respects, however, the pattern is bound to be a familiar one. Consider the practical certainty that an undeclared aggression, a surprise attack, will usher in any future war. Then recall the vast array of military activities which are rooted in basic facts of psychology—facts as to the limits of human capabilities, the modifiability of behavior, the processes of learning, the springs of action, the interplay of personalities, the nature and distribution of individual differences in capacity, knowledge, skill, temperament and leadership throughout the population, both military and civilian. War may change its aspect with every generation. Drastic changes in the nature of man take place more slowly. This is why it is reasonable to suppose that as long as there is need for an army of occupation, a world police, or a system of national defense, just so long will there be technical problems of military psychology (*10*).

Based on an address before the Psychology Section of the New York Academy of Sciences, January 20, 1947. The views expressed are personal and not official.

PROBLEMS OF BIOMECHANICS

In connection with the *design of new equipment*, for instance, urgent psychological problems will continue to arise out of hard facts regarding the limits of human capacity. There are bounds to man's ability to perceive, to discriminate, to judge, to respond with the requisite promptness, and to manipulate handles, wheels, triggers, knobs, levers, and pointers with the necessary precision, without succumbing to the effects of avoidable fatigue and distress which have too often been inadvertently imposed by designers of military as well as of industrial equipment. Ordnance experts and development engineers will be under pressure to produce better, more effective weapons, vehicles, airplanes, instrument panels, scales, signals, radar screens, goggles for night lookout or scouting duty, and complex fire-control systems for use aboard ship or on shore. Designers wrestling with such problems during the past six years have not infrequently called upon physiologists and psychologists to bring to bear their insights, their knowledge of human capabilities, and their methods of scientific experimental attack (*4*, *5*, *6*, *8*). Psychological development of procedures for the most *effective use of equipment*—for instance, of electronic aids—also proved to be valued by technical services of Army and Navy. As a consequence, tasks have been made less complicated, performance easier and more precise, with diminished strain. The usefulness of new equipment has been broadened, and the precious time required to master it has been shortened.

These types of contribution are vividly illustrated by the accomplishments of the Psycho-Acoustic Laboratory directed by S. S. Stevens at Harvard. This enterprise markedly improved the transmission of speech by telephones and interphone equipment, developed better headsets and earphones, found and demonstrated the optimal position of the microphone relative to the lips of the talker, ascertained the speech sounds most frequently misunderstood, devised superior oral codes, and helped to work up a short, intensive training course in telephonic speech which increased intelligibility and reduced the errors in vocal communications. It is no rash assumption that rigorous, systematic, ingenious, practical laboratory research of this kind will continue to be demanded by the military services.

A similar area is the *design of clothing and gear* adapted to the comfort, the convenience, and the mental as well as the physiological capacity of the wearer when campaigning in the desert, in the tropics, or in the frigid polar regions, when escaping from a submarine, or when bailing out of a jet-propelled airplane in the stratosphere.

Developing ways of reliably *ascertaining preference for duty* in a region of bitter cold or in the steaming tropics is a related field of inquiry into which military psychologists have hitherto made only exploratory forays.

Does it really matter whether a soldier is going to like it in the far North better than he would in a tropical jungle? Should this factor of his personal preference be given any weight when deciding as to his assignments? Isn't it of the essence of military organization and discipline that each soldier goes where he is needed and does what he is told? The answer is known to every leader. He appreciates how greatly his own tasks of direction and command are simplified when his followers have had at least some share in choosing their arm or service, their military specialty, their assignments, and their comrades, and have identified their own objectives with those of their organization and its commander.

RESOURCES OF MAN POWER

This leads headlong into the military problem of *the discovery, development, and conservation of aptitudes*, of human capacities and talents of every sort.

To maximize the Nation's human resources by facilitating the growth and optimal utilization of potential capabilities is a worthy goal during any period of peace. If again the war clouds gather, it will become an imperative of survival. The United States has traditionally been extravagant of its man power, as of water power, forests, grazing lands, oil deposits, wild life, and other endowments. During World War II we wasted a good many people, both in essential industries and in the armed forces. Certain chemists needed for technical research were, for example, kept on duty in hospitals making routine laboratory determinations which a careful high school boy could be taught to do with precision in two days. Fortunately, in spite of wasted skills, we still had a little man power to spare after all the really indispensable activities had somehow been staffed. But never again! If we should find ourselves once more at war, it is likely to be the enemy who will have man power enough and to spare. So, within the next few years, we must place ourselves in a superlative position to husband our abilities and strength.

Slow Learners

Sharply defined psychological problems of man-power conservation are seen at the two extremes of the ability scale. Toward the lower extreme is the Army's number-one headache, the slow learner. From this category I exclude the feeble-minded. The imbeciles and the morons, together with the psychotics, the epileptics, the inadequate personalities, should have been debarred, and commonly were, at the Induction Stations. Slow learners were those who, having been accepted, found the going pretty tough during the early months of training, required a longer-than-average period of basic instruction, and, even then, in most instances had to be either dropped from the service or assigned to noncombatant duty as unskilled laborers because they did not have what it takes to be infantrymen in these days when so much depends on the knowledge and resourcefulness of the individual soldier.

A large majority of these slow learners were illiterate, not necessarily in the sense that they could not read or write their own names. They were functionally illiterate in that they could not read well enough to make any practical use of the Army's instructional aids, when trying to learn what a soldier must know. This is the Army's definition of literacy: the ability to read as well as the average person who has had the benefit of four years of elementary schooling. (Hence, one sees occasional reference to "fourth-year literacy.")

There were altogether too many of these functional illiterates. During 1941 and 1942, thousands of them had to be released. Others continued to congest the training centers long after they were supposed to be ready for assignment to units or sent overseas as reinforcements. Since the War Department well knew that reinforcements would be in great demand in 1943 and 1944, the military psychologists and educators undertook a heroic job of salvage. They developed ingenious schemes and practical devices with which to teach grown men to read and to figure (*9*). Eighteen Special Training Units were established with a capacity of 30,000 men. Expert instructors were appointed to oversee the teaching, which had to be skillful, intensive, swift. To these Special Training Units, beginning in the late spring of 1943, went all illiterate inductees and also all who, though able to read some, did not pass the Army General Classification Test with a standard score of at least 60, *i.e.* two sigmas below the mean.

It was found that a large proportion of these slow learners could be salvaged within a period of 13–17 weeks, in the sense that they actually learned to read at the fourth-year level and, on transfer to the regular training camps, were able to keep pace with the course of instruction. Between June 1943 and September 1945 a total of 218,000 of these illiterates and 69,000 others who had not made at least Standard Score 60 on the AGCT were dispatched to one of the Special Training Units immediately after being accepted for military service; and 83 per cent of them in three or four months time learned enough reading, arithmetic, and Army discipline to enable them to go forward on a military career, instead of continuing to be a drag on the war effort or having to be discharged.

Today America is confronted squarely with these two astonishing facts; first, the disappointingly high rate of functional illiteracy; second, a demonstration that this social disease can be greatly ameliorated whenever we decide to pay the cost in effort and in dollars.

The military psychologists have done their part. The civilian economy must now pick up the burden. This is not only the task of providing excellent educational opportunities for all the children, rural and urban, white and colored, north, east, south, and west; there is also the need of getting more than 1,000,000 young men now of military age over the barrier that separates the functionally illiterate from the literate and the distressingly slow learners from the rest of us. This will have to be done, if the Nation's resources of man power are to be maximized in this generation.

Rapid Learners

Studies of our civilian army make it clear that the national economy also has unfilled obligations to a great many young men who, on the AGCT, would score in the top third of the distribution, in Army Grades I or II, *i.e.* Standard Score 110 or better. Within this upper range the armed forces find all their potential commissioned officers and many able noncoms. Leaders in civilian undertakings likewise tend to come from these intellectual levels. Here are most of the successful professional men, scientists, engineers, architects, technological specialists, general managers, editors, teachers, social workers, psychologists. More than half of the West Point Cadets are in Army Grade I; none is below Grade II. An overwhelming majority of college men score within this range. In Fig. 1 and Table 1 may be seen the relation of learning readiness as measured by this test to level of education achieved before entering the Army, in a population of 105,521 enlisted men constituting a thin cross section of the enlisted strength of the Army as of March 31, 1944. A large fraction of group B, those who had begun but not completed a college course, would have graduated in due time if their schooling had not been interrupted, since half of the men in this sample had been only 18–24 years old when they joined the service. Nor does our coverage include those men who had gone to Officer Candidate School and been commissioned. Their records would have increased the proportions in Army Grades I and II and in the higher educational categories. Even so, the conclusion cannot be escaped that the number presumably having the intellectual capacity to benefit from higher education is substantially greater than the number actually permitted to carry their schooling into that zone of achievement.

TABLE 1

DISTRIBUTION OF 105,521 ENLISTED MEN BY TEST SCORE AND SCHOOLING

	AGCT Grade					Total
	V	IV	III	II	I	
A. College graduates	3	51	343	2,111	1,201	3,709
B. 1 to 3 years college	27	400	2,694	7,781	2,478	13,380
C. Finished high school	100	2,102	9,362	13,239	2,232	27,035
D. 1 to 3 years high school	757	8,184	12,533	7,508	624	29,606
E. No high school	6,354	15,765	7,446	2,076	150	31,791
Total	7,241	26,502	32,378	32,715	6,685	105,521

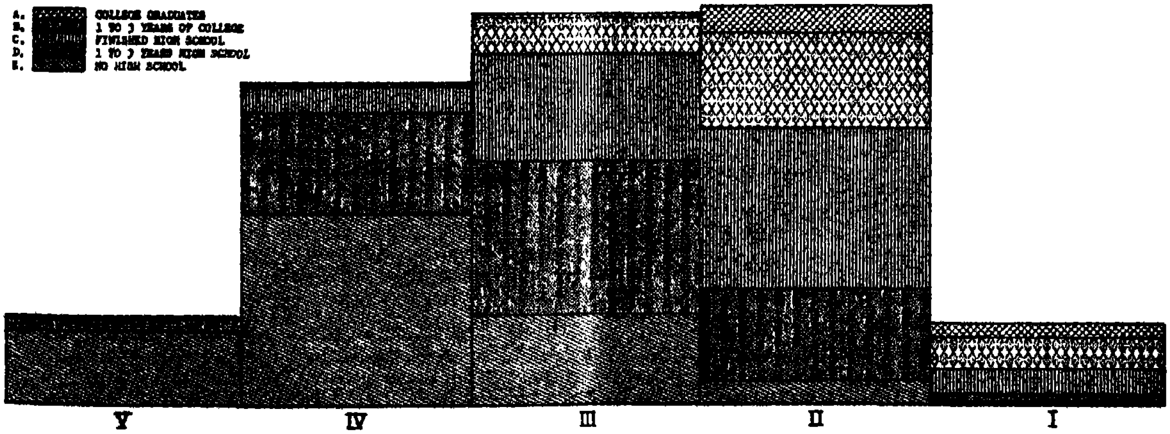

FIG. 1. Relation of learning readiness to educational level.

Another study discloses the sobering fact that, among more than 3,000,000 men in these higher levels of learning ability, the personnel classification interviewers found almost 1,000,000 who had not even completed a high school course, much less gone on to a technological institute, a college, or a professional school (*1*). Why? For some, their calling, their vocation, had led elsewhere. Schools and colleges are not the only places in which education, cultivation, personal effectiveness, and professional competence can be achieved. But for the majority of these bright soldiers, the decisive reason for discontinuing their education had been economic. Here, then, is a pool from which to augment the Nation's short supply of scientists, technologists, scholars, professional men, and military leaders. An ample number of competitive scholarships providing for board as well as tuition would be one form of insurance against unnecessary waste of such intellectual resources. The National Science Foundation, if established, will help in some measure to meet this need.

Potential Leaders

The problem of selecting military leaders is not solely one of identifying the highly educated competitors, or the brightest. Indeed, beyond a certain indispensable minimum of knowledge and intellectual acumen, the factors which tend to differentiate the best officers from the very good are not measured with precision by means of tests of educational achievement or scholastic aptitude. This was one of the impressive findings from a notable research project of the War Department which had as its purpose the development of sound procedures for use in selecting from among the wartime officers those who would receive commissions in the Regular Army.

This study, ordered by the General Staff early in 1945, was planned in detail and carried to completion by The Adjutant General through the Personnel Research Section of the Classification and Replacement Branch of his office. It came to be known as the Officer Integration Project. Thirteen thousand officers collaborated as subjects in the field trials. Others took part as interviewers, examiners, or evaluators of efficiency. It was in many respects the most searching, thorough, ingenious, and fruitful research project in personnel selection of which I have knowledge.[1]

The story, told in the *Infantry Journal* by J. M. Clarke (*3*), emphasizes the stark necessity for procedures that validly differentiate the best from the very good; for in the first integration, which took place in June 1946, only about 9,000 could be chosen from among 108,582 officers who had filed applications. Competition was especially stiff in the Air Forces, where 59,000 had applied for the 3,900 commissions available at that time. The question was: Which ones among the superior applicants would be of greatest value to the service during the years ahead? Instruments of prediction had to prove their validity within the topmost range. Another challenging prerequisite was that choice had to be made by procedures which do not permit bias, prejudice, or favoritism to creep in and corrupt judgment.

Among the instruments which survived extensive experimental tryouts were: first, a General Survey Test of educational background, which served as a preliminary hurdle to screen some applicants from further consideration but which carried no weight in the final combined score; next, a very detailed Biographical Information Blank, on which many of the statements to be checked get at the candidate's attitudes toward himself, toward other people, and toward the work and career of an officer; third, an Officer Evaluation Report, which utilizes several ingenious devices for securing information that is at once impartial and significant; and finally, a session with a practiced Interview Board whose procedures and ratings are concentrated on eliciting, observing, and reporting only those aspects of behavior which can be drawn out and reliably appraised during a group discussion.

These instruments had to be tailor-made, to fit the Army officer population. In the long biographical inventory lists and the officer evaluation reports, words and phrases were used which officers are known to employ when describing fellow officers of whom they approve or disapprove. Officers in the experimental population had been given a chance to write sketches about other officers, good and poor; and from about 800 such essays were culled phrases, trait terms, and characterizations to be tried out. Which of these actually apply to the best officers more often than to others? That was a crucial question.

The psychologists did not try to decide such questions by arguing about them. Instead, they used the empirical, experimental approach. They first established three criterion groups, made up of best officers, average officers, and poor officers, using a procedure called the nominating technique. As Mr. Clarke says (p. 10):

> There is no way of knowing that a leader actually is a leader until other men have acknowledged his leadership, and the acknowledgment is demonstrated by results. Those who are best able to judge whether a man is achieving results that demonstrate leadership are his fellow officers. It seemed certain that if all the officers in a battalion, squadron or similar unit rated a fellow officer as outstanding, he was actually outstanding, and that if they unanimously rated him as poor, he was actually poor.

With this as a basic working principle, War Department experts visited installations all over the United States and supervised the rating by their fellow officers as well as by their commanders of 13,000 wartime officers—many of whom had been in combat together. On 3,000 out of the 13,000 the ratings by all who made them were in close agreement. There were 1,127 outstanding, 1,019 mediocre (that is, near the average) and 854 poor. On the other 10,000 there was some, though often merely a slight, difference of opinion among fellow officers and superiors taken together. But on the 3,000 all equals and all superiors agreed. And when all a man's fellow officers and superior officers agree that he is outstanding (or mediocre, or poor) as a leader there is not much

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[1] The following officers and professional staff members were immediately responsible for preparing and validating the procedures recommended for adoption: Lt. Col. M. W. Richardson, Lt. Col. D. E. Baier, Major Roger M. Bellows, Capt. Reign H. Bittner, Capt. E. A. Rundquist, Robert J. Wherry, William R. Wilson, Francis F. Bradshaw, Edwin R. Henry, Douglas H. Fryer, and Harold A. Edgerton. Indorsement of the recommendations of this technical staff was made, after careful study of the procedures and the results of the practical tryouts, by the following members of the Committee on Classification of Military Personnel Advisory to The Adjutant General: W. V. Bingham, H. E. Garrett, C. F. Hansen, L. J. O'Rourke, C. L. Shartle, and L. L. Thurstone.

> doubt about it, especially when actual performance in combat and elsewhere is part of the basis for judgment.
>
> The three groups among the 3,000 men (1,127 outstanding, 1,019 mediocre, and 854 poor)—groups of men who had all been rated with the greatest possible precision and practical care—were used in the final tryouts of the leadership tests.

It was required of every biographical item, test, or rating instrument that it contribute to the differentiation of these groups. For instance, it had been remarked of certain officers that they "had had Junior ROTC training in high school." But a check of biographical data showed that this statement applied equally often to officers in the poor, average, and best groups; so, into the wastebasket it went, along with many other characterizations. Only statistically significant items were given appropriate weights in the final scoring scheme.

Another step consisted in finding out what officers think as to which of these traits and phrases are the more laudatory or the more derogatory. After these data were systematically secured and the trait rankings brought into relation with the validity data, it was possible to select pairs of terms which match in that they are commonly considered to be equally favorable, but which are actually far apart in discriminatory effectiveness. Suppose, then, that we were to bring together into one cluster five of these terms, two of which are commonly considered to be equally unfavorable, two favorable, and one indifferent or intermediate. You are asked to check with a plus mark the term that most nearly characterizes you, and with a minus mark the one which least applies to you. Suppose, further, that you are a very superior officer. If you check this and all other items on the form conscientiously and accurately, the scoring scheme will give you a high rating. But if you are a superior officer in all respects except that you are not quite frank about yourself and decide to mark the items, not as truthfully as you can, but in the way in which you imagine that they had better be marked in order to get a high score, the consequence is that your score tends to be nearer the average or mediocre than it ought to be.

Similarly, suppose a Major is evaluating a Captain who is the poorest leader in his battalion, an officer he personally dislikes; and suppose, in order to rid the Army of such riffraff, the rater decides to mark the Evaluation Report in a way which he thinks will surely make the Captain out to be a very poor officer, instead of marking in each instance the trait term which most nearly characterizes this Captain and the one which least applies to him, as the instructions prescribe. Again the attempt to beat the game defeats itself. The final score tends to drift away from the bottom of the scale in the direction of the colorless average. This pairing of valid and invalid terms, matched for apparently equal value on a scale of desirability, marks a distinct step forward in the evolution of rating systems.[3]

How good is this program of selecting wartime officers for integration into the regular establishment? It appears, from evidence accumulated in 1945 and early 1946, that if traditional procedures had been used, approximately 70 per cent of the officers chosen would have been above average and 30 per cent subaverage; while of the 9,000 chosen with the new procedures, statistical analysis indicates that less than 2 per cent are in the subaverage category. Mr. Clarke mentions estimates of the money savings expected to accrue from the elimination in advance of so many mediocre officers. The new system should eventually save around $250,000,000. Inept leaders are an expensive luxury.

Still better tests of leadership will be constructed in due course. Already steps have been taken to improve the methods of evaluation developed for the integration project and adapt them to peacetime requirements for a periodic officer-evaluation procedure. Appraisal of leadership in noncommissioned officers is a related topic of current research, as is the selection of enlisted men for Officer Candidate School. In the *Army Information Digest* (7) is a crisp description of the forced-choice technique and other features now embodied in the Biographical Information Blank and the Evaluation Report as adapted to such purposes.

OTHER CONTINUING PROBLEMS

The problem of selection for *assignment in the higher ranks* is certain to be brought forward from time to time. Only recently an officer distinguished as a combat commander and also as a policy maker inquired: "How can we pick the best planners—officers of the rank of Lieutenant Colonel or higher—for duty on the General Staff? Several Generals here, and at other headquarters too, would like to know." Of course I countered by asking whether he could supply some authentic criterion groups: officers who have proved to be superb planners, and officers with similar assignments who have been unable to deliver the goods. With such a start, a typical inquiry might be made into the significance of detailed biographical inventory data, interest schedules, test performances, interview procedures, and rating items chosen with an eye to their possible validity as indicators of exceptional ability to think out plans. Which stigmata are really significant only research will tell—research conducted outside of the library and requiring close observation, ingenious experimental design, patient follow-up, and sound statistical analysis of all relevant data. This problem is one of many in the quest for superior talents—problems that call for scientific attack during a period of peace and tranquillity. A good time to mend the roof is between rainstorms.

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[3] The principle was developed by R. J. Wherry, of the Personnel Research Section, Adjutant General's Office, who credits the germ of the idea to Paul Horst, supervisor of Personnel Selection Research, Procter and Gamble Company.

Nothing has been said of the recurring and insistent problems of *clinical psychology*, a field of highest practical importance in any fighting force. Military psychologists specializing in this difficult subject are wanted today, not only in neuropsychiatric wards of Army hospitals, but also in the consultation services at training centers, to help in preventing minor maladjustments and forestalling serious mental illness. Their usefulness will increase with the completion of current and projected studies of exceptional behavior in relation to the psychiatrists' diagnoses, treatments, and follow-up.

The systematic study of *attitudes and opinions*, too, is a technical field not to be neglected by an army which aims to keep a finger on the pulse of its personnel. Opinions flow along. You can treat them scientifically or unscientifically. You ignore them at your peril.

Equally essential in war is contact with the mind of the enemy. How best can we monitor and analyze his broadcasts? How should we ascertain the effects of military campaigns or of different patterns of strategic bombardment on the morale of his civilian populations and his troops? What truths of ours, what ways of informing him, are our most potent weapons of *psychological warfare?*

If ever again America should approach the catastrophe of war, answers to these imperative questions of military psychology should already be at hand.

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Obituary

Sir Joseph Barcroft
1872–1947

With the death of Sir Joseph Barcroft on March 21, the School of Physiology at Cambridge, England, lost one of its most distinguished and best-loved members. A student of the founders of the School—Foster, Langley, and Gaskell—Sir Joseph, perhaps more than anyone else, preserved its traditions and, through the host of students and collaborators he attracted, brought those traditions to international recognition.

Joseph Barcroft was born on July 23, 1872, at Newry, County Down, Ireland. He received his early education at Bootham at York and the Leys at Cambridge. After receiving the B.Sc. at London he went to Kings College, Cambridge, in 1893 with an exhibition. There he gained first-class honors in Parts I and II of the natural sciences tripos and was graduated with the B.A. in 1896.

Barcroft then began to study the mechanisms which provide the tissues with oxygen, an aspect of physiology then unexplored at Cambridge and the one which formed his dominant interest during almost half a century of active investigation. The earliest studies were designed to estimate the rate of oxygen utilization by a variety of tissues—the submaxillary gland, the kidney, the pancreas, and the heart in activity and at rest. These, some of which were made alone and others in collaboration, provided the basis for the recognition in quantitative terms of what Barcroft phrased as "the call for oxygen."

With the cumbersome apparatus for the estimations of the blood gases available at the turn of the century, data on gaseous metabolism of tissues were hard earned. Extraction methods were time consuming and required relatively large amounts of blood. To facilitate his estimations, Barcroft devised and improved the differential manometer, an instrument which opened new possibilities for the study of tissue metabolism and one which today, either in its original form or Warburg's modification, is used in biological laboratories throughout the world for the study of the respiratory exchanges of small amounts of tissue as well as for following the reactions of isolated enzyme systems. The invention of the differential manometer opened the way for Barcroft's classical studies on factors affecting the combination of oxygen and hemoglobin, to which his attention was drawn by a desire to estimate the oxygen or pressure in tissues at rest and in activity. For this purpose he sought to use the dissociation curve of the blood, but the variations in the form of the curves he prepared, as well as those of others, led him to investigate the effects of acids and salts on the affinities of hemoglobin for oxygen, a study which laid the foundation for our present knowledge of the role of chemical changes in the blood in the release of oxygen at the tissue capillaries.

From the physiology of hemoglobin, Barcroft turned his attention to a description of the circumstances responsible for the transfer of oxygen from the alveolar spaces into the red cell. Until about 1922, physiologists were divided in their views concerning the role of the pulmonary epithelium. The researches of one school, led by Haldane, appeared to support the view that the epithelium was capable of secreting oxygen into the blood; the other, including Keogh and Barcroft, that the epithelium acted as an inert membrane. The controversy, a classic in its freedom from prejudice and narrowness, was decided in favor of the latter view, by evidence provided in large measure by Barcroft's studies made on himself while he lived for several days in a glass chamber at reduced oxygen pressures, the essential blood samples being drawn from an exposed artery in his forearm.

Interest in the effects of reduced oxygen pressures on the body mechanisms providing oxygen to the tissues were also explored during two expeditions which Barcroft led, the first to Monte Rosa in 1911, and the second to the Peruvian Andes in 1922. Knowledge gained on these expeditions and in the laboratory was used by Barcroft in World Wars I and II to the direct advantage of his country by its application to aviation warfare. It also provided the basis for his interest in blood stores and his search for the source of red cells delivered to the circulating blood as the individual entered environments of decreased oxygen pressure. The classical researches on the spleen and the circumstances under which it stores or delivers red cells are now familiar to all who have an acquaintance with physiology.

Differences in the bloods of fetuses and their mothers and their apparent functional advantages led Barcroft to study the respiratory function of the blood in the fetus. The readiness to follow an interest "beyond the visible horizons," so characteristic of the man, served to develop the whole field of fetal physiology, including the functions of the placenta, the circulatory changes at birth, and the functional development of the nervous system. The results of his researches and those of his collaborators in this field—a field which some claim Barcroft established in its own right—are summarized in *Researches on prenatal life*, which appeared late last year.

All of these investigations were based upon simple ideas and questions and carried through with direct methods and simple techniques. They were not designed to gather details except in so far as they were essential for the development of method in technique; they were designed to reveal principles of function or integrations. Once these were at hand, Barcroft moved on to expand his chosen field of interest, leaving the intricacies to be explored by those with special knowledge.

The record of Barcroft's investigations has been said to be one of the most fascinating in the annals of science, for few investigators have revealed so much of themselves in their writings. His freedom from all that was artificial in life, his charity and warmheartedness, are nowhere better revealed than in the first edition of *The respiratory function of the blood*. Anyone who opens its pages joins him in the high adventure of investigation, for there the pitfalls and pleasures of research are presented in a fashion which has encouraged and will continue to encourage young men to find in the pursuit of science a worthy purpose in life. There are revealed the personal qualities which enabled Barcroft—and Michael Foster before him—to attract young men with special talents and to direct their attention toward problems they were peculiarly fitted to solve. His flare for presenting a problem simply and his readiness to encourage and assist young men to careers in physiology and the allied sciences drew to him a host of students and collaborators.

In the years following his student days and before World War I, when he served as demonstrator and then lecturer in the University, few students entered the Cambridge laboratory who did not work with him at some time during their stay. After the War and until he retired from the Chair of Physiology (which he held from 1926 to 1937, succeeding Langley), students came to his laboratory from all over the world, many of them from the United States. Through his pupils and collaborators from this country, his Dunham Lectures given at Harvard in 1929, and the Terry Lectures at Yale in 1926, Barcroft made a special contribution to the development of physiology here. This, together with his achievements as an investigator, was recognized by his election as a foreign associate of the National Academy of Sciences in 1939.

Many other honors came to Sir Joseph. He was elected to the Royal Society in 1910 and was awarded a Royal Medal in 1922 and the Copley Medal in 1943. He was knighted in 1935. Although he retired in 1937, his years of service to science were not at an end. His broad biological interests and his talents as an administrator were utilized during World War II, when he served on advisory committees of the War Office and the Royal Air Force. To the establishment of the Nutrition Society he gave his unfailing devotion and served as its chairman from 1945 until his death. When the Agricultural Research Council elected to promote fundamental research on the large, domesticated animals by the establishment of a Unit of Animal Physiology at Cambridge, Sir Joseph was chosen as its director. In this post, with undiminished vigor, Barcroft continued to look and "to venture beyond the visible horizon," his craft in full sail to the end, for he died en route to his home for luncheon after a full morning in the laboratory.

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NEWS *and Notes*

At ceremonies held on August 11 at Brookhaven National Laboratory ground was broken on the site of the first peacetime atomic pile, to be used for fundamental research in medicine, physics, biology, chemistry, and engineering. According to Lyle Borst, head of the group which designed the pile, it will contain a number of improvements which will make it the most flexible pile in the world. Although similar in general form to that at Oak Ridge, its neutron density will be several times greater. The air-cooled pile, which is expected to be in operation by mid-1948, will be housed in a building approximately 120 feet long by 100 feet wide and more than 6 stories high, flanked by two laboratory wings, each nearly 100 feet long. The total cost will be about $10,000,000. The H. K. Ferguson Company, designers and builders of the Oak Ridge thermal diffusion plant, will be responsible for engineering design and construction. Sumner T. Pike and William W. Waymack, members of the U. S. Atomic Energy Commission, addressed the group present for the ceremonies.

About People

Joseph H. Burckhalter, for the past five years coordinator of research in synthetic antimalarial drugs for Parke, Davis & Company, Detroit, has been appointed associate professor of pharmaceutical chemistry at the University of Kansas, effective in September.

Alan Hisey, of the Medical College of Alabama, has been appointed associate professor of biochemistry, School of Chemistry, Metallurgy, and Ceramics, University of Alabama, Tuscaloosa.

Edward S. Ross has been promoted from associate curator to curator, Department of Embryology, California Academy of Sciences, San Francisco; **Hugh B. Leech,** formerly of the Dominion Entomological Laboratory, Vernon, B. C., has been named assistant curator; and **Don Graeme Kelley,** Berkeley, has been appointed editor of the Academy's monthly publications.

Edward U. Condon, director, National Bureau of Standards, and **Detlev W. Bronk,** chairman, National Research Council, have accepted appointments as members of the Scientific Advisory Committee of Brookhaven National Laboratory. This Committee, created to assist and advise the director of the Laboratory, consists also of the 9 scientific members of the Board of Trustees (*Science*, May 9, p. 491).

Wilson Popenoe, director, Escuela Agricola Panamericana, Zamorano, Honduras, received the honorary D. Sc. degree from Pomona College at its last commencement.

Kinichi Watanabe, formerly of the University of Hawaii, has been appointed assistant professor, Department of Physics, Wabash College, Crawfordsville, Indiana.

Henry Quastler, radiobiologist, Carle Clinic, Urbana, Illinois, has been appointed half-time associate research professor of radiobiology, Departments of Zoology and Physiology, and Physics, University of Illinois.

George W. Stiles, head, Pathological Laboratory, Bureau of Animal Industry, U. S. Department of Agriculture, Denver, Colorado, since 1918, retired on June 30 after 45 years of service in the Department.

Harold C. Urey, Institute for Nuclear Studies, University of Chicago, has been named to represent the American Chemical Society on the U. S. National Commission for UNESCO.

C. L. Gazin, paleontologist, Smithsonian Institution, has begun a search for fossils in the Huerfano formation in southern Colorado. Among the specimens Dr. Gazin hopes to find are the tillodonts of the Eocene period, which are among the earliest known warm-blooded animals and which combined rat and bear characteristics.

Lowell T. Coggeshall, chairman, Department of Medicine, University of Chicago, has been appointed dean of the Division of Biological Sciences, which includes 13 Departments as well as the Zoller Memorial Dental Clinic, Nursing Education, the Food Research Institute, and the Institute for Radiobiology and Biophysics.

Robert M. Stabler, formerly assistant professor of zoology, University of Pennsylvania, has been appointed associate professor and acting chairman, Department of Biology, Colorado College, Colorado Springs.

P. B. Pearson, professor of biochemistry and nutrition, Agricultural and Mechanical College of Texas, has been appointed dean of the Graduate School, succeeding **T. D. Brooks.** Dr. Pearson assumes his duties September 1.

Grants and Awards

Derrick T. Vail, professor of ophthalmology, Northwestern University, and consultant to the Army Medical Department, was recently awarded the Legion of Merit for "outstanding services" as senior consultant in ophthalmology in the European Theater. The presentation was made by Major Gen. Paul R. Hawley, chief medical director, Veterans Administration, and formerly chief surgeon, European Theater of Operations.

Louis Schmerling, Universal Oil Products Company, Chicago, will receive the first Ipatieff Prize in chemistry on September 15, during the national meeting of the American Chemical Society in New York City. The $3,000 prize, honoring achievements in the study of catalysis or high blood pressure, was established by Vladimir N. Ipatieff, director, Ipatieff High Pressure and Catalytic Laboratory, Northwestern University, and Mrs. Ipatieff. The award, which will be presented to Dr. Schmerling for his contribution to the knowledge of catalytic reactions of hydrocarbons, will be given every three years to a chemist under 40 years of age.

J. C. Geiger, director of public health, City and County of San Francisco, has recently been awarded the Gold Cross of the Royal Order of Phoenix from the Greek Government, the Royal Order of the Crown of Orange Nassau, officer grade, from the Queen of Holland, and the Meritorious Medal of the Canadian Legion of the British Empire Service League from the president of the Dominion Command, Ottawa, Canada, for his services and contributions to public health.

The School of Dentistry, Emory University, has received from the National Institute of Health a $3,655 grant, according to Dean Ralph R. Byrnes. The grant, to be administered by James A. Miller, associate professor of anatomy, will be used for an analysis of factors in the newborn influencing survival under anoxia.

The Jane Coffin Childs Memorial Fund for Medical Research has recently announced the following appropriations, totaling $62,764.50, for support of cancer research projects and fellowships for one year: Samuel C. Harvey, Yale University School of Medicine, $3,000 for statistical studies of cancer, and $8,500 for clinical and laboratory studies of cancer; Yale University School of Medicine, Administration, $1,000 for maintenance of the animal house; C. C. Little and P. A. Gorer, Roscoe B. Jackson Memorial Laboratory, $4,500 for continued study of the mammary tumor inciter by Dr. Little, and $250 for 3 months for continued study of immunological aspects of genetics by Dr. Gorer; Yale University School of Medicine, Administration, $500 for expenses of seminars of the Atypical Growth Research Unit; Eugene L. Opie, Rockefeller Institute for Medical Research, $4,000 for continued studies of changes in cells undergoing malignant transformation, and dietary influences on liver tumor formation; Robert G. Green, University of Minnesota Medical School, $5,000 for continued studies on the nature and mode of action of the milk agent; Alexander Haddow and associates, Chester Beatty Research Institute, Royal Cancer Hospital, London, supplement of $2,500 for continued support of the Institute's research program on chemical carcinogenesis, viruses and cancer, and chemotherapy of cancer; Owen H. Wangensteen, University of Minnesota Medical School, $5,000 for continued investigations of gastric carcinoma; Aubrey Gorbman, Barnard College, Columbia University, $800 (September 15–June 30) for continued study of atypical growth in the thyroid gland; Edwin D. Murphy, University of Tennessee School of Medicine, $4,660 for the continued study of the biological behavior of experimental and human tumors; Paul R. Burkholder, Yale University, $3,000 for the study of mechanisms of induction and propagation of atypical growth in plants; T. M. Sonneborn and W. J. van Wagtendonk, Indiana University, $8,500 for studies on the biochemical nature of substances concerned in transmission of hereditary cytoplasmic factors in *Paramecium*; William B. Atkinson and Howard C. Taylor, Jr., Columbia University College of Physicians and Surgeons, $4,000 for cytochemical investigations on hyperplastic and malignant uterine tissues in women in relation to their endocrine state; Joshua Lederberg, fellow, $1,554.50 (September 7–June 30) to work with Francis J. Ryan, Department of Zoology, Columbia University; Charles Grégoire, fellow, $1,500 (October 1–June 30) to work in the Department of Cancer Research, Rockefeller Institute for Medical Research; and $4,500 to cover various projects of the Fund. These appropriations bring the total project and fellowship allocations for the year 1947–48 to $171,308.66.

The Fund also announced the appointment on July 1 of M. C. Winternitz as acting director, Board of Scientific Advisers, succeeding Stanhope Bayne-Jones, who was appointed president of the Joint Administrative Board of the New York Hospital-Cornell Medical Center (see *Science*, June 27, p. 660).

Fellowships

A limited number of Fellowships in Medicine, designed to provide an opportunity for research training in the basic medical sciences or in their application to clinical investigation, will be available through the American College of Physicians from July 1, 1948 to June 30, 1949. Stipends will range from $2,200 to $3,000. The closing date for applications is November 1, 1947. Forms will be supplied on request to: The American College of Physicians, 4200 Pine Street, Philadelphia 4, Pennsylvania.

The American Association of University Women is offering a series of fellowships for graduate study or research for 1948–49. The National Fellowships are open to American women for study here or abroad, and the International Fellowships include one to enable a Latin-American woman to study in this country and others which are open to members of the International Federation of University Women. The majority carry a stipend of $1,500. Detailed information may be obtained from the Secretary, Committee on Fellowship Awards, American Association of University Women, 1634 I Street, N.W., Washington 6, D. C.

Colleges and Universities

Iowa State College plans to build a 3-story connecting link between the chemistry and physics buildings, joining the two buildings now housing integral parts of the Institute for Atomic Research, of which F. H. Spedding is director. The new building will contain spectrographic laboratories, facilities for tracer chemistry, reading room for the joint use of the Physics and Chemistry Departments and the Institute, staff and administrative offices, conference rooms, and research laboratories.

Stanford University has disclosed the development by Lester M. Field, electrical engineer, School of Engineering, and his staff of a traveling wave radio tube which could amplify simultaneously 250,000 telephone conversations or 300 black-and-white television broadcasts or 100 in color. The slender, foot-long tube, doubling the ability of earlier models to cover a wide range of frequencies and handle a huge volume of radio traffic, differs from ordinary radio tubes in that it provides a system of lengthy exposure of microwaves to a stream of electrons from which the microwaves build up their energy. The new tube will facilitate commercial expansion of television, since the vast number of frequencies it covers will enable many television stations to operate simultaneously. It also provides a feasible method by which long-distance lines can be replaced by a chain of radio relay stations in which the tubes will provide ample amplification and room for simultaneous transmission of large volumes of telephone and radio traffic.

The University of Notre Dame has established in its Department of Aeronautical Engineering a unique engineering flight demonstration program, designed to supplement theoretical principles of aerodynamics and airplane dynamics taught in the classroom with actual flying experience. Lt. Col. Francis X. Bradley, A. C. Reserve, instructor in mathematics, is providing instruction in flight demonstration in the air, while R. S. Eickenberry, associate professor of aeronautical engineering, is conducting a concurrent series of lectures to provide the theoretical basis for the flight program.

The New Mexico School of Mines has announced the following appointments to the teaching staff at Socorro: **John Harty,** formerly associate professor of physics, St. Louis University, as professor and head, Department of Physics; **Rafael Sanchez-Diaz,** formerly professor and head, Department of Mathematics, College of Agriculture and Mechanical Arts, University of Puerto Rico, as professor and acting head, Department of Mathematics; **William W. Long,** formerly an exploration engineer with the Freeport Sulphur Company of New York, as assistant professor of mining engineering; and **Albert A. Koch,** of Pasadena, California, as associate professor of engineering.

A $200,000 contract for leather research centering at the Tanners' Council of America Laboratory on the University of Cincinnati campus has recently been renewed by the Quartermaster General of the Army. This research program, which has been under way for several years, involves the following projects and institutions: University of Cincinnati—production of highly water-resistant leather for Army shoes, study of temperature and humidity conditions and their effect on leather held in stock piles, and development of synthetic tanning materials; Massachusetts Institute of Technology—basic research on the composition and structure of skins; Lehigh University—study of all mineral tannages; Ohio State University—development of artificial fatlike materials; Institute of Paper Chemistry—study of new tanning materials; Eastern Regional Research Laboratory, USDA, Philadelphia—improvement of military insoles; and U. S. Bureau of Standards—study of the increased wearability of leather by use of plastics and other resinous materials. Fred O'Flaherty, director of the Tanners' Council Laboratory, is coordinator of the program.

A special surgical unit for plastic and maxillofacial surgery and neurosurgery is being developed at the University of Texas Medical Branch, Galveston. This unit, which will probably be opened in September, was planned by the late Albert Singleton. It will be under the direction of T. G. Blocker, Jr., professor of plastic and maxillofacial surgery, and Samuel Snodgrass, associate professor of neurosurgery.

At the 95th annual commencement of the Woman's Medical College of Pennsylvania, held on June 6, Louise Pearce, president of the Board of Corporators, conferred degrees on 35 graduates. Carmen C. Thomas, president of the Alumnae Association, presented special citations to members of the Class of 1897, 7 of whom are still living. Dr. Pearce announced plans for the expansion program of the College, to be completed by 1950, the centennial of its founding. These include raising a $4,000,000 fund for general endowment and for physical expansion of facilities of both College and Clinic.

Meetings

The Fourth International Cancer Research Congress, which is to meet in St. Louis on September 2–7 (*Science*, August 8, p. 124) will have as its secretary general Frank McGurk, of Montgomery, Alabama. Mr. McGurk, on detached service with the Congress through August and September, is assistant regional director and state relations officer for the American Red Cross in Alabama.

The Pennsylvania Academy of Science, which held a well-attended meeting on the campus of the Johnstown Center of the University of Pittsburgh and Johnstown Central High School, April 4–5, was addressed by J. Kenneth Doutt, curator of Mammalogy, Carnegie Museum, Pittsburgh, on "Life on an Unexplored River in the Hudson Bay District." A symposium was held on flood control and soil conservation. The Junior Academy, which met at the same time, was attended by a large number of enthusiastic junior scientists from all parts of the state. The spring 1948 meeting is scheduled to be held at Grove City College; the summer 1948 meeting, at State Teachers College, Kutztown; and the spring 1949 meeting at Franklin and Marshall College.

The Eighth World's Poultry Congress will be held in Copenhagen, Denmark, in the summer of 1948. Morley A. Jull, Poultry Department, University of Maryland, who was recently elected vice-president, U. S. Executive Committee on the Congress, has explained that these Congresses are held under the auspices of the World's Poultry Science Association, an international organization composed of government poultry leaders, experiment-station research workers, college teachers and extension personnel, and poultry producers and distributors. Regulations on the marketing of poultry products and the control of poultry diseases in the various countries are discussed, as are methods of conducting extension work among farmers and commercial poultrymen, and practical problems confronting producers in the breeding, feeding, incubation, management, and marketing of all classes of poultry.

The International Geographical Union is to hold its next Congress in Lisbon, Portugal, in September 1948. Among the topics to be considered are cartography, physical geography, biogeography, human and economic geography, colonial geography, the history of the subject, and methodology. Further information may be obtained from George B. Cressey, head, Department of Geography, Syracuse University, who has recently been appointed chairman of the National Committee of the United States. This Committee serves under the Division of Geology and Geography, National Research Council.

The Office of Naval Research is supporting a program of biological research at Pt. Barrow, Alaska, in a project called the Pt. Barrow Arctic Science Station. The initial biological program will be carried out by Laurence Irving, Per F. Scholander, Reidar Wennesland, Walter Flagg, and Erik T. Nielsen, of the Department of Zoology, Swarthmore College, and Donald R. Griffin and Raymond J. Hock, of the Department of Zoology, Cornell University, working under contracts between their respective institutions and the Office of Naval Research.

In order to assess the basic biological conditions of Arctic life, the party will study the metabolism of warm- and cold-blooded animals, the expenditure and economy of animal heat, and the orientation and metabolism of Arctic birds during migration. Following these studies through the transition from summer to winter and from winter to summer will give evidence concerning the basis for biological acclimatization and adaptation to an Arctic environment, to the stresses imposed by climate, and to the profound and rapid seasonal changes which occur.

Pt. Barrow, the only station in the possession of the United States lying within the Arctic circle, faces an Arctic ocean with shores, waters, and ice biologically only little explored. Southward, the tundra land rising gradually to the Brooks Range has not been studied in its biological details. Over these regions modern transportation is rapidly extending geographical, geological, aerological, and oceanographic surveys, which provide clear outlines upon which to examine the patterns of Arctic life and its active adjustments to many of the high-latitude conditions which cover large and important areas of the earth. These areas have hitherto been screened from view by the difficulties of travel and existence. Now that Arctic outposts have become accessible, it is possible to carry on detailed and consistent studies of Arctic biology which will permit accurate descriptions of life in high latitudes. Scientific experience upon the cold frontiers of the North will also improve, by the contrasts which it presents, our knowledge of life in other climates.

According to Laurence Irving, director, Edward Martion Biological Laboratory, Swarthmore College, from whom the announcement was received, "it is believed that the initiation of this program will lead to sustained biological research in the Arctic which will develop the means for making human life in the Arctic more effective and more interesting."

The American Library Association, 50 E. Huron Street, Chicago, has just published a new *Subject guide to United States government publications*, by Herbert S. Hirshberg and Carl H. Melinat. The book, which sells for $5.00, presents documents by subject rather than by office of issue. The documents analyzed are selected from those of the last 20 years, with emphasis on the more recent ones and on subjects of continuing and current interest. Some 1,200 subjects are covered in its 236 pages, and many cross-references and bibliographies are included.

A new international journal of genetics is currently being published by Oliver and Boyd, Ltd., of London and Edinburgh. Bearing the title *Heredity*, the journal, which will devote itself principally to original articles, will appear three times a year. Volume 1, Part I, was published in July. The editors are C. D. Darlington, John Innes Institution, London, and R. A. Fisher, Whittingehame Lodge, Cambridge, England. The first issue contains a section on genetic research in Britain, 1939–45; a bibliography of Italian and German research for the same period; and original articles by Th. Dobzhansky, Ø. Winge and E. Ditlevsen, D. Lewis, Otto H. Frankel, Sydney C. Harland, L. L. Cavalli and G. Magni, D. S. Falconer, and Margaret E. Wright. Single numbers sell for 14/–, or $3.00 net; an annual subscription, for 40/–, or $8.50.

The Helen Hay Whitney Foundation for basic scientific research in rheumatic fever has recently been formed. T. Duckett Jones has been appointed medical director of the Foundation, with temporary offices in the New York Hospital, 525 East 68th Street, New York City.

The formation and functions of the Associates of the Food and Container Institute were revealed at a press conference in Chicago on August 7. The new nonprofit organization, comprised of companies and corporations in the food, container, and allied industries, has listed the following objectives: (1) to promote the dissemination to industry of fundamental scientific information pertaining to foods and containers; (2) to function as a clearinghouse on research activities; (3) to attract scientists to engage in food and container research; (4) to ascertain fundamental research problems; (5) to minimize unnecessary duplication of research; (6) to keep members of the Associates informed of the Institute's activities; and (7) to assist the Institute with technical information relating to industrial experience and practice. The chairman of the Interim Board of Directors, which will manage the affairs of the Associates prior to a regular election, is Harry J. Williams, Wilson and Company, who is also chairman of the Executive Committee. Offices of the Associates are located at 1849 W. Pershing Road, Chicago 9, Illinois.

The Quartermaster Food and Container Institute now has projects under way in 15 institutions dealing with the discoloration of foodstuffs; 17 institutions are investigating the problem of rancidity; 13 are concerned with microbiological spoilage; 26 are working on nutritional deficiencies of foods; 24, on food acceptance research; and one project is devoted to the study of containers.

A new periodical publication appearing in two sections and entitled *Applied Scientific Research* will be published by Martinus Nijhoff, The Hague, The Netherlands, beginning in September. The two sections, (A) Mechanics, Heat and (B) Electrophysics, Acoustics, Optics, will provide a medium of publication for original technical-scientific investigations in these fields. Articles will be preferably in English, although French or German will be permitted. Subscriptions, which should be sent to the publisher, may be obtained for each section separately at 20 guilders (about $7.60) per volume. Manuscripts should be sent to the secretary, Dr. Ir. C. W. Kosten, Laboratorium voor Technische Physica, Mijnbouwplein 11, Delft. Published under the auspices of the Central Organization for Applied Scientific Research of the Netherlands, the Netherlands Physical Society, and the Royal Institute of Engineers, the journal will be supervised by a Governing Board, an Editorial Board, and a group of foreign editors.

The British Scientific Instrument Research Association formally opened its new laboratories last month. The laboratories are located at "Sira," Southill, Elmstead Woods, Chislehurst, Kent.

Make Plans for—

Mathematical Association of America, September 1–2, Yale University, New Haven, Connecticut.

Fourth International Cancer Research Congress, September 2–7, St. Louis, Missouri.

American Astronomical Society, 77th Meeting, September 3–6, Dearborn Observatory, Evanston, Illinois.

First International Biometric Conference, September 5–6, Marine Biological Laboratory, Woods Hole, Massachusetts.

American Psychological Association, September 9–13, Detroit, Michigan.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS
by Readers

After many years of devastation China is now, with the help of the United Nations, effecting a recovery of her national well-being. This recovery involves the rehabilitation of her basic industries, among which her fisheries are of considerable importance. The rehabilitation of this industry involves not only building new vessels, assembling new gear, and organizing new marketing institutions to replace those destroyed during the war, but also developing an effective body of scientific data in relation to these fishery resources and the means of both production and distribution, to enable the fishery to be reorientated to the modes of fishing available today. Although powered vessels were operated in Chinese waters, from Chinese ports, before the war, the greater proportion of the industry was carried on by traditional methods, which, although comparatively effective, were in many cases primitive and incapable of any great development. Since little was known about the general resources, new developments were practically impossible, natural changes and fluctuations had to pass unexplained and merely endured, and no active program could be developed for the effective management of these resources. These problems are aggravated by the fact that, for various reasons, the move for the development of powered-vessel operations is of considerable urgency.

The Chinese National Fisheries Research Institute, recently established under the Ministry of Agriculture and Forestry, has been charged with the task of carrying out the investigations necessary to guide the Chinese fisheries industry during the difficult period of the immediate future and to serve as basis for permanent work in fisheries administration. Comprehensive plans have been drawn up for the conduct of research work and for the associated extension work by which the results of research can be communicated to the industry and a flow of recruits to the research field may be developed and maintained. However, implementation of this program is being seriously delayed by the lack of equipment and the inadequacy of a trained staff. The undersigned are therefore making a general appeal for assistance. At the present moment the Institute possesses hardly a measuring board, let alone the customary laboratory equipment for microscopic and other techniques. It possesses only a handful of books—generally Japanese—and has none of the standard fisheries publications. While the Institute plans eventually to acquire literature by purchase and exchange, such a program will necessarily be somewhat delayed and prolonged. It is thought that various individuals and institutions might be in a position to anticipate such a program by making gifts or exchanges in advance of any publication by the Institute. Any literature in general and marine biology, fisheries-biology, -economics, and -technology, hydrology, planktology, and related fields of oceanography, and limnology would be valuable to the workers of the Institute. It is less likely that gifts of equipment could be made. However, workers of the Institute would be grateful to be informed of any new techniques or special technical developments which workers in other laboratories have discovered. (Ling Shao-Wen, *Director*, Gideon Ting-wei Lew, *Vice-Director*, G. L. Kesteven, *UNRRA Fisheries Operational Specialist, Shanghai.*)

Smith (*Univ. Kans. Publ. Mus. nat. Hist.*, 1946, **1**, 93–96) presents a well-drawn figure of the mouth parts of the tadpole of *Bufo cognatus* Say which differs materially from my figures accompanying the original description of this larva (*Copeia*, 1936, 14–30, Figs. 11–13). He also discusses the marked similarity between his figure of *B. cognatus* and Wright's figure (*Proc. U. S. nat. Mus.*, 1929, **74**, Art. 11, Pl. 5, Fig. 6) of a tadpole stated by the latter author to be *B. compactilis* Wiegmann.

Three possible interpretations are suggested by these facts: (1) Smith's tadpoles might have been of *B. compactilis*, (2) Wright's tadpoles might have been of *B. cognatus*, or (3) the tadpoles of the two species may have mouth parts so similar as to be practically identical.

Fortunately, I have at hand several large, personally collected series of the tadpoles of each species, all of which were fixed in the field in Bouin's solution and kept since in alcohol. All are in excellent condition. Those of *B. cognatus* were collected near Norman, Oklahoma, in 1941; those of *B. compactilis*, in various places in southwestern Oklahoma (chiefly in Greer County) in June 1946.

Even a superficial study of these tadpoles was sufficient to reveal the true situation. The third possibility is the correct one. The specimens from which my figures were drawn were atypical, and Smith's figure shows the typical condition. Dr. Wright's figure is also correct for *B. compactilis*, and his excellent description of color pattern and general external appearance of the tadpole of *B. compactilis* proves conclusively that he did not confuse the two species.

This situation raises interesting questions. Does the similarity in mouth parts of these two species of toads indicate a closer phylogenetic relationship than is commonly supposed? Broader than this, how much can larval characters in general be relied upon as indicating phylogenic relationships? How much similarity is due to convergent evolution in adaptation to similar habitats and ecological relationships? That no one can answer such questions with assurance at this time indicates certainly that tadpoles and other larval forms deserve much more study than they have received to date. (Arthur N. Bragg, *University of Oklahoma, Norman.*)

P. Martens, well-known Belgian cytologist, and a director of the journal, *La Cellule*, writes that as the result of the war and the German occupation the future of the journal is in serious jeopardy. Issues have been appearing irregularly and at rather long intervals. Subscriptions have fallen off to a marked degree not only because subscribers in a number of countries have been unable to pay for them but because contacts have not yet been re-established with such countries as Russia, Germany, Japan, and Italy. It is to be hoped that cytologists will rally to the support of *La Cellule* and urge the purchase of subscriptions in their own institutions where such are not pending. (Clarence Sterling, *Department of Botany, University of Illinois.*)

TECHNICAL PAPERS

Adenosinetriphosphatase Activity of Human Serum[1]

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Recent studies suggest that adenosinetriphosphatase (ATP-ase) plays an important role in muscular contraction (*3*). Attention has also been directed toward the significance of adenosine triphosphate (ATP) in the metabolism of other tissues (*2*), although apparently there have been no studies of blood serum. In the course of an investigation of the ATP-ase of human serum, a rather definite pH optimum was found at certain acid values of pH. This phenomenon has not been reported for the ATP-ase of certain animal tissues (*1, 2*).

ATP, prepared and characterized as previously described (*8*), was used as the sodium salt. Serum from patients and presumably healthy subjects was prepared from venous blood, care being taken to avoid hemolysis. ATP-ase was determined in a system designed to make the concentration of enzyme the rate-determining factor. Five-tenths cc. of serum was added to 2.5 cc. of ATP solution in 0.1 M veronal-HCl or acetate buffer at various values of pH. Maximum activity was obtained with 3.38 and 9.67 micromoles of ATP at pH 8.9 and 4.8, respectively. After incubation at 37° for one-half to two hours, the clear trichloracetic acid filtrate was analyzed for inorganic phosphorus (*4*). Controls with buffer and ATP or serum alone were employed. The data presented are corrected for serum inorganic phosphorus and nonenzymatic hydrolysis and are expressed as micromoles of phosphorus split from ATP/cc. of serum/hour.

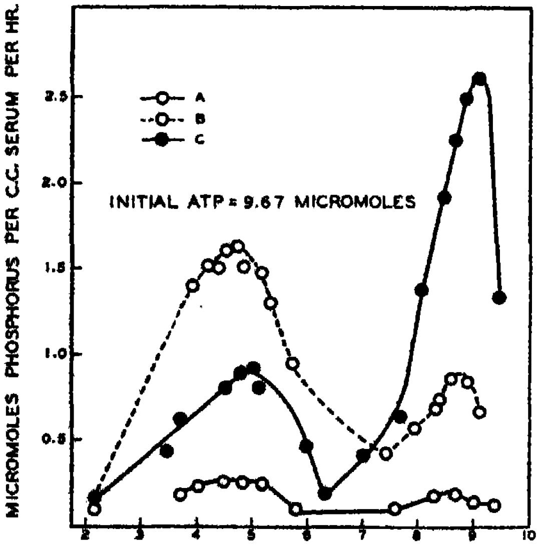

FIG. 1

Fig. 1 presents pH activity curves for the serum ATP-ase of a normal subject (A), a patient with cirrhosis (B), and a patient with metastatic carcinoma of the prostate (C). The activity exhibits maxima in the ranges of pH from 8.7 to 9.1 and 4.6 to 5.1 in all sera studied. At pH 8.9, all three phosphate groups of ATP are hydrolyzed by normal and abnormal sera, since the inorganic phosphorus liberated is greater than the decrease in acid-labile phosphorus. Furthermore, muscle adenylic acid is usually completely split under similar conditions. At pH 8.9, 0.29–0.32 micromole of adenylic acid was split (maximum hydrolysis = 0.32 micromole). On the other hand, the corresponding values at pH 4.8 were less than 0.06 micromole, except for sera with elevated "acid" phenylphosphatase, where the values were less than 0.18 micromole. There is no consistent relationship between ATP-ase at pH 4.8 and "acid" phenylphosphatase.

TABLE 1

ATP-ASE OF SEVERAL HUMAN SERA*

Diagnosis		Micromoles P/cc. serum/hour	
		pH 8.9	pH 4.8
Normal subjects†	1	0.18	0.26
	2	0.34	0.46
	3	0.19	0.38
	4	0.53	0.26
Prostatic carcinoma cases (bony metastases)	1	5.09	1.13
	2	2.86	3.0
	3	3.91	1.43
Breast carcinoma (liver metastases)		2.01	1.88
Cirrhosis		0.87	1.63
Infectious hepatitis		0.96	0.86

* These values were obtained with 3.38 and 9.67 micromoles of ATP at pH 8.9 and 4.8, respectively.

† The mean values for the sera of 21 presumably healthy subjects were 0.30 (s ± 0.1) at pH 8.9 and 0.41 (s ± 0.1) at pH 4.8.

In a preliminary study of various human sera, comparatively high values of ATP-ase were frequently found in patients with bone and liver disease (Table 1). However, the present data permit no diagnostic implications. The relative amounts of activity at pH 4.8 and 8.9 vary with different sera. In addition, greater amounts of substrate are necessary at pH 4.8 than at 8.9 for maximum activity.

The present evidence is compatible with the hypothesis that the two ATP-ase optima represent different enzymes. This was substantiated for the "acid" and "alkaline" phosphomonoesterases of beef kidney by Perlman and Ferry (*6*).

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[1] This study was carried out at Gallinger Municipal Hospital, Washington, D. C.

Barrenscheen and Lang (*1*) found a specific ATP-ase in guinea pig and rabbit liver with pH optima of 8.2 and 9, while Satoh (*7*) reported that ATP was dephosphorylated by the combined action of phosphomonoesterase and pyrophosphatase. DuBois and Potter (*2*) report an optimum of pH 9 for rat liver ATP-ase. Studies of two specimens of pooled rat serum have failed to reveal an acid optimum for ATP-ase activity. It is possible that such species differences as have been found for prostatic phosphatase (*5*) exist with regard to "acid" ATP-ase.

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The Mode of Action of 7-Methyl Folic Acid

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The primary action of sulfonamides (*1*) has been found to be directed against the incorporation of p-aminobenzoic acid into pteroylglutamic acid. 7-Methyl folic acid has been reported (*2*) as an effective folic acid displacing agent. The 7-methyl folic acid used in these experiments is N-(4-(((2-amino-4-hydroxy-7-methyl-6-pteridyl)-methyl)-amino) benzoyl)-1(+)-glutamic acid. To determine the mode of action of folic acid displacers, attempts were made to counteract the growth-inhibiting action of sulfonamides and folic acid displacers by various agents. *Staphylococcus aureus* #209 grown in a bouillon medium was used as the test organism. Table 1 gives the results obtained.

TABLE 1

Counteraction of 7-Methyl Folic Acid and Sulfathiazole

Compound	p-Amino-benzoic acid	Pteroyl-gluta-mic acid	Pteroic acid	Gluta-mic acid	p-Amino-benzoyl 1 (+) gluta-mic	Sulfa-thiazole
7-Methyl folic acid . .	+	+	+	−	−	+
Sulfathiazole	+	−	+	−	−	−

+ = counteracts
− = no effect

The concentrations per 10 ml. of chemicals used were: 7-methyl folic acid, 1–10 mg.; sulfathiazole, 0.05–1.0 mg.; p-aminobenzoic acid, 1–5 mg.; pteroylglutamic acid, 1–5 mg.; pteroic acid, 1–10 mg.; glutamic acid, 1–5 mg.; and p-aminobenzoyl-1(+)-glutamic acid, 1–5 mg.

When *Staph. aureus* is the test organism, it seems that the action of the sulfonamide is to prevent the incorporation of p-aminobenzoic acid into pteroic acid. Pteroylglutamic acid does not counteract the sulfonamide, which indicates that pteroic acid and not pteroylglutamic acid is involved in *Staphylococcus* metabolism. The fact that p-aminobenzoylglutamic acid does not counteract the sulfonamide would be anticipated if pteroic acid is the vital factor in growth. Pteroic acid is more effective than p-aminobenzoic acid in counteracting sulfathiazole.

With the same test organism, methyl folic acid is counteracted by pteroylglutamic acid, pteroic acid, and p-aminobenzoic acid but not by p-aminobenzoyl-1(+)-glutamic acid, indicating the synthesis of pteroic acid as the first step in the formation of pteroylglutamic acid. Pteroic acid, p-aminobenzoic acid, and pteroylglutamic acid are equally effective on a molar basis in counteracting methyl folic acid. It seems probable that methyl folic acid interferes with the synthesis of pteroylglutamic acid at the stage of pteroic acid formation and at the stage of union with glutamic acid. It has the further capacity to displace formed pteroylglutamic acid. Thus, methyl folic acid represents another displacement compound incorporating into one molecule the capacity to inhibit the synthesis of and displace a given metabolite. As with a sulfonamide, methyl folic acid interferes with the incorporation of p-aminobenzoic acid into pteroylglutamic acid. The counteraction of methyl folic acid by sulfathiazole indicates similarity of structure resulting in mutual interference superseding that of interference with the metabolism of pteroylglutamic acid.

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Effect of Age of Infection Upon the Oxidative Metabolism of *Trypanosoma lewisi*[1]

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When the nonlethal protozoan parasite, *Trypanosoma lewisi*, is inoculated into its natural host, the rat, reproduction of the trypanosomes occurs only during the first few days of the infection. Thereafter, reproduction is inhibited, and the population consists entirely of adult, nonreproducing organisms (*2*). Taliaferro and his associates (*5*) have shown that cessation of parasite reproduction is caused by an antibody which specifically inhibits the reproduction of the trypanosomes, and in 1932 Taliaferro termed this antibody ablastin.

In an investigation of the mechanism of action of ablastin upon *T. lewisi*, the oxidative metabolism of trypanosomes taken from rats at different ages of infection has been compared. The study was limited to infections 2–10 days of age in which no number crisis had been brought about by the appearance of trypanolysins (*1*). Reproduction of the trypanosomes ceased on the fourth or fifth day of infection. Table 1

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[1] Supported by grants from the Dr. Wallace C. and Clara A. Abbott Memorial Fund and the John Rockefeller McCormick Memorial Fund of the University of Chicago.

[2] Mr. and Mrs. Frank G. Logan Research Fellow.

shows that, compared with young reproducing organisms, the adult nonreproducing trypanosomes respiring on glucose have a higher rate of oxygen uptake, a higher respiratory quotient, and an increased sensitivity to malonate inhibition of oxygen uptake. These differences are all statistically significant. The increased rate of oxygen consumption per 10^9 organisms may be due to the fact that the mean size of trypanosomes in young infections is less than that in old ones (*4*), but the changes in respiratory quotient and malonate sensitivity are independent of variations in the mean size of trypanosomes. The malonate inhibition of respiration is interesting, because it is believed that succinate is not oxidized by *T. lewisi* (*3*). Added fumarate does not relieve the malonate inhibition.

TABLE 1

Day of infection	Oxygen uptake		Respiratory quotient		Inhibition of oxygen uptake by 0.01 M Na malonate	
	No. observations	Mean oxygen uptake (micromoles/10^9 organisms)	No. observations	Mean R.Q.	No. observations	Mean inhibition (%)
2	4	46	3	0.76	3	13
3	7	49	2	0.75	2	10
4	6	42	1	0.95	1	15
5	5	63	1	0.92	1	23
6	3	54	1	0.75	1	22
7	1	79	1	0.99	1	11
8	5	63	1	0.94	1	18
9	2	65	1	0.91	1	28
10	3	56	2	0.98	2	27
Arrangement of four-fold tables	Under 5 days—5 days and over Under 55 micromoles—55 micromoles and over		Under 4 days—4 days and over Under 0.85—0.85 and over		Under 5 days—5 days and over Under 18 per cent—18 per cent and over	
P	0.015		0.012		0.011	

Each Warburg vessel contained 0.75–1.50 × 10^9 trypanosomes in 1.0 cc. Ca-free phosphate saline (pH 7.6, 0.130 M total cation concentration) containing 0.01 M glucose and 2.0 per cent bovine serum albumin. Oxygen uptake and R.Q. were determined by the direct method of Warburg. Observations were started after equilibration for 15 minutes in an atmosphere of air at 37.5° and were continued for a period of 120 minutes. To test the statistical significance of the differences between young and adult trypanosomes, χ^2 and P were calculated from four-fold tables, constructed as shown above after application of the Yates correction for continuity.

The possible relation of the changes in oxidative metabolism to the inhibition of the reproduction of the parasites by the specific antibody, ablastin, is now being investigated.

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Fluorescence of Red Blood Cells

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Keller and Seggel and also Seggel (*3*) reported on the presence of red fluorescing reticulocytes in the blood of man and of animals. The significance of these fluorocytes in relation to the problems of anemia aroused the interest of many investigators, and by 1940 there had appeared an extensive series of German and French contributions on this subject. The articles by Seggel, Ungricht, Chytrek, and Watson, Grinstein, and Hawkinson (*4*) are of particular interest because of their views on the relationship between the number of fluorocytes and other clinical findings.

After the appearance of certain peculiar cases of anemia at the Mayo Clinic it was thought that Seggel's method of fluorescent examination might be of assistance. Accordingly, there was set up a fluorescence microscopic ensemble which permitted the satisfactory examination of fluorescing coproporphyrin mounted on a quartz slide. When, however, no fluorocytes were observed in the blood specimens of clinically selected cases, in newly-born guinea pigs, or in rabbits poisoned with phenylhydrazine, it seemed possible that this was due to inadequacy or insufficiency in one or both of the following: (1) absolute brightness of the fluorescence microscopic image, and (2) image contrast, brightness level, and the resolving power of the eye under very low illumination. Although one of us had considered similar problems with the ordinary light microscope (*1*), it was thought that these problems in the case of the fluorescence microscope were peculiar and required careful experimental analysis. An analysis of the factors involved in fluorescence microscopy is reported in another communication (*2*).

During the course of our investigations, in which we were able to increase the intensity of the ultraviolet illumination through the selection of better optical components, sources of radiation, and instrumental arrangement, various examinations were made of blood samples clinically selected as being anemic. Each sample of fresh blood was examined after dilution with physiologically isotonic saline solution. Sufficient dilution was required to permit the cells to lie flat. No other method of dilution was used, since Seggel had found that any kind of isotonic saline solution could be used if sublimate was absent.

Examinations of the fluorescence of samples of blood from a newborn guinea pig, from a rabbit poisoned with phenylhydrazine, and from a patient suffering from pernicious anemia gave negative results until an adequate intensity of illumination was obtained. Under favorable conditions, brightly fluorescing reticulocytes were observed. In the case of samples of blood drawn from a rabbit to which phenylhydrazine had been administered on three separate occasions during the course of four days, it was estimated that the fluorocytes were about 1 per cent of the erythrocytes observed. High intensity of illumination, accurate focusing, and proper dark adaptation of the eye must be obtained and maintained in order that fluorocytes of low order of fluorescence may be observed.

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As already reported by Seggel, fluorescence of blood cells is an evanescent phenomenon, and its duration is related to the original brightness. In the case of the longest period of fluorescence of a fluorocyte observed by us, it was found that 120 seconds elapsed before the fluorocyte was too faint to be seen. In contrast, about the shortest time involved in a low-order fluorescence was only 4 seconds. While these data are considerably more extreme or of a wider time range than those reported by Seggel in the case of a rabbit to which phenylhydrazine had been administered, it cannot be concluded that, in our experiments, more coproporphyrin was present in the fluorocytes. It is probable that the conditions of observation were different in two particulars from those under which Seggel worked: (1) intensity of illumination and (2) level of dark adaptation.

Samples of blood from a patient having pernicious anemia were examined under optimal conditions and with the benefit of previous experiences in this type of investigation. Although fluorescence was observed, it was of a yellowish-green hue similar to that of willemite and not the red fluorescence characteristic of coproporphyrin. Although the significance of this yellowish-green fluorescence is not known to us, the presence of a brightly fluorescing yellowish-green pigment in a reticulocyte undoubtedly indicates the presence of some other modification of the normal hemoglobin of red blood cells.

The number of fluorocytes per unit volume of blood cannot be correlated with the amount of fluorescing pigment in the blood. This statement is deduced from the probability that the total time of visibility for fluorescence per unit area under constant intensity of illumination is roughly proportional to the fluorescing pigment present. This being the case, if the population is one of fluorocytes of uniform size, the total statistical time of fluorescence should be proportional to the amount of pigment per unit volume. These considerations would explain the lack of correlation between the fluorocyte count and other clinical findings in the evidence submitted by Seggel and others and would offer a basis for the criticism of Seggel's work by Chytrek. These considerations are especially pertinent, since in no case is it possible to determine the correct total time of fluorescence. The number of reticulocytes carrying the reddish fluorescent pigment must be in excess of those observed, since some cells will contain so little of this pigment that fluorescence will be below the level of visibility or will last for too short a period to permit recognition. In general, however, the number of fluorocytes which can be observed may be taken to indicate the severity or the state of the disease.

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IN THE LABORATORY

Improved and Improvised Sterilizing Containers for Bacteriological Petri Dishes and Pipettes

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In spite of the close of the war it is still difficult to obtain such simple and relatively inexpensive items as sterilizing containers for bacteriological Petri dishes and pipettes, and some of those available have a common defect which this writer has observed for several years and now wishes to record so that manufacturers may correct it if they wish to do so.

For example, one type of round Petri dish container, 10 inches tall, has a lid 2½ inches high which slides over 1½ inches of the container. The lid fits so closely that its removal is often extremely difficult. A lid ½ inch high would be just as effective and would save much effort in handling. There is on the market an aluminum container, without a rack, with a shallow lid for four dishes, which is quite ideal. It is cheap, durable, and altogether satisfactory.

Some commercial containers for pipettes are open to the same kind of criticism as that just mentioned for Petri dishes. One sample has a cover 6 inches long, of which 2 inches fit over the container. Both container and cover are finely made of copper, are seamless, and are almost as closely fitted as a piston in a cylinder. It generally requires considerable effort to close or open one of these, and the upper third of the pipettes is exposed to aerial contamination when the lid is off, if they do not actually fall out.

Another container, made of stainless steel, not seamless, is 17 inches long, with a lid 1½ inches long and a sliding area of 1 inch. This is much easier to handle and exposes only ½ inch of the pipettes to the air. A loosely fitting lid ½ inch long with a short screw would be even better.

The writer has often used as containers for pipettes the discarded cartons in which adhesive tape or surgical plasters have been purchased. Some of these have shallow screw tops, and they will stand repeated sterilization in the dry air sterilizer very well, but not in the autoclave.

They are particularly useful for sterilizing Pasteur pipettes, but are too short for standard commercial pipettes. This difficulty has been met by lengthening them with an additional section fastened with Scotch tape, which also withstands repeated dry air sterilization remarkably well.

Coffee cans make very satisfactory substitutes for the commercial containers for Petri dishes, but they should first be boiled in a strong solution of lye to remove the lacquer.

A Method for Determining Sensitivity to Penicillin and Streptomycin[1]

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The sensitivity of a microorganism to penicillin or streptomycin is an important consideration in determining the choice of a chemotherapeutic agent. Furthermore, the development of resistance during the course of therapy may make it advisable to modify dosage or to change drugs. The imperative need for this information has led to the development of a number of methods which can be used to measure sensitivity. These follow the general pattern of making a series of dilutions of the drug in some nutrient vehicle and then inoculating the medium with a culture of the organism being tested. Sensitivity is shown by a failure to grow in one or more of the dilutions. Existing methods are cumbersome and require the use of a sterile technique. Since a pure culture of the organism being examined is needed, testing may be delayed for several days.

To overcome these objections we have incorporated penicillin and streptomycin into compressed tablets 7/32 inch in diameter and weighing 60 mg. each. The tablet base found to be most satisfactory contains dicalcium phosphate, starch, and gum acacia. The granulation is dried and passed through a fine screen, after which the calculated amount of the dry antibiotic agent is added and mixed thoroughly. To obtain an indication of the relative sensitivity of the organism, tablets containing varying amounts of drug were prepared. We have used penicillin tablets containing approximately 1.0, 0.5, and 0.1 Oxford units, and streptomycin tablets containing 1.0, 0.1, and 0.01 mg., respectively. Susceptibility of the organism to the drug is shown by a clear zone around the tablet (Fig. 1) which has a diameter proportional to the amount of drug contained.

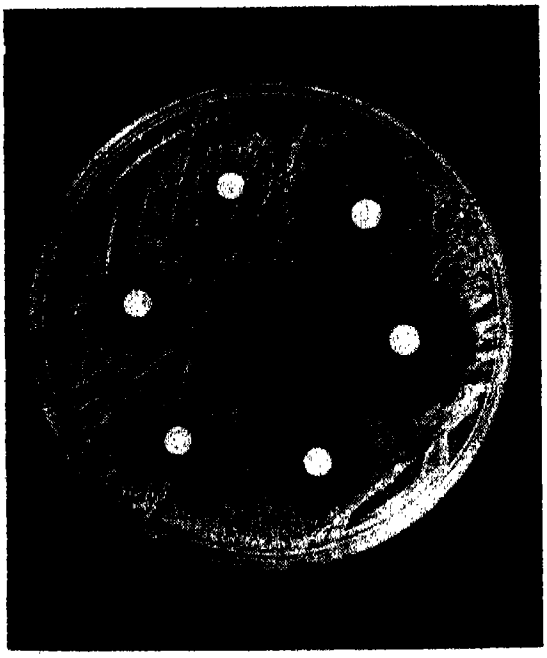

FIG. 1. Sensitivity of *Staphylococcus aureus* to penicillin and streptomycin. From the top, reading clockwise, the tablets contain 1.0, 0.5, 0.1 Oxford units of penicillin, 1.0, 0.1, 0.01 mg. of streptomycin.

The use of the tablets is very simple. An agar plate is streaked heavily with the organism being tested, and the tablets are dropped into position with forceps. The plates are incubated after inversion and are read when growth of the organism is sufficiently advanced to disclose susceptibility or resistance. Any type of solid media can be used as the base, since the results can be read by reflected light. We do not regard the precise measurement of the inhibition zone as being important, since its only value is the suggestion it may give as to therapeutic dosage. We have made no effort to sterilize the tablets before use. The growth of contaminants around the tablet is uncommon and, in any event, does not interfere with the observation. A control tablet containing only the ingredients of the granulation was run routinely for a while, but since there has never been any inhibition around it, we have discontinued this practice.

An important advantage which this method offers is the speed with which results may be obtained. Material such as sputum, exudates, and infected body fluids can be tested directly without preliminary subculture, since, even if contaminating bacteria are present, the various sensitivities can be observed.

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[1] This work was aided by a grant from Boyle and Company, Los Angeles.

Sea Water Systems at Marine Laboratories

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Since many salt water systems are being installed or remodeled throughout the world, a few suggestions concerning installation and materials should be timely.

The selection of metals to be used in such a system depends on their toxicity to animals and how rapidly they go into solution or combination with salt water ions to form toxic substances. Also, there is great variation in the amount of impurities carried by different metals. For example, generally speaking, cast iron from our West Coast is made mainly from scrap and carries a much greater percentage of impurities than does the pure eastern cast iron. From our experience with different metals, lead, tin, and pure-grade cast iron are the only ones that we feel safe in using where contamination must be held at a minimum, and even cast iron should not be left long in contact with salt water. Some metals having particularly bad lethal effects on larval forms are copper, zinc, and aluminum. Therefore, no brass or bronze fittings should be used in the salt water system where the water is expected to be used for experimental embryology. Monel metal, Inconel metal, etc. contain copper; stainless steel is also undesirable. Dishes made of such metals could not possibly be used safely for the culture of larvae, and this is our test for their safe use in any part of a salt water system. I therefore recommend that they not be used.

In purchasing metals such as lead, tin, or cast iron for use in a salt water system, pure grade should be specified and, if possible, tested out as containers for culturing larvae—for example, those of sea urchins. If a dish made of the metal being considered can be used safely for culturing larvae over a period of two weeks, it can be used safely in the salt water system. It should be thoroughly washed before using. Such tests, of course, include a change of pure sea water every 12 hours, and the sea water should be passed through a nontoxic filter and come in contact only with clean glassware. Pure sea water should be obtained, even at a considerable distance at sea if there is any doubt as to harbor or shore contamination. This sea water should be filtered immediately and then may be kept in clean carboys for a long period of time. Such tests should be carried on at uniform temperatures equal to, or slightly below, that of the open ocean water in the vicinity of the laboratory.

An efficient salt water system at a marine laboratory is the nucleus upon which the activity of the laboratory depends, and too much care cannot be exercised in its efficient operation. One is justified in looking with suspicion upon experiments performed where impure salt water is used.

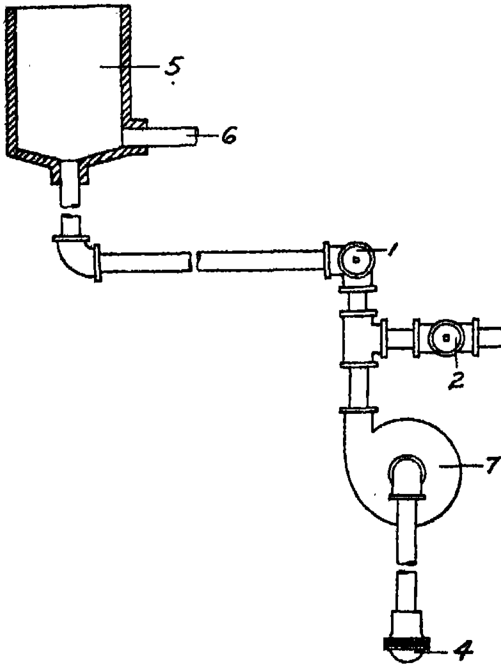

FIG. 1. Diagram of a salt water system: 1 and 2, cast iron stopcock valves; 3, drain pipe; 4, foot valve; 5, storage tank; 6, lead pipe to aquariums; 7, pump.

There are several fundamentals which should be carefully considered:

(1) The laboratory should be located near an available source of clean sea water.

(2) The pipe from the source of salt water should be of the proper material and should be as short as possible.

(3) Arrangements should be made for flushing this pipe before pumping more water into the storage tank (Fig. 1).

(4) The storage tank should hold sufficient water for about 1½ days. Even if the tank is larger, only enough water to last for that length of time should be pumped in each day.

(5) The lowest level in the storage tank should be 10 feet or more higher than the aquariums.

(6) Lead pipe and rubber stopcocks should be used from the storage tank to the aquariums.

(7) Hot water should be used to flush the pipes from the aquariums to the storage tank.

(8) The storage tank should be properly constructed of nonlethal materials.

None of these requirements increases the cost of installation or operation of the system; in fact, the cost is decreased. Exclusive of the work of one man for 70 days, the system at the Kerckhoff Marine Laboratory cost $958 in 1933. The sea water at the aquarium tables is as pure as the outside ocean water and is never more than 1°C. higher than the outside water. This system supplies two large laboratories, two smaller laboratories, a large aquarium, and a large live tank for storing animals.

A further discussion of the fundamentals listed above follows:

(1) Too many marine laboratories are built from an architectural standpoint rather than for a utilitarian purpose. If a marine laboratory is to function as such, it must be close to ocean water.

(2) Pure cast iron pipe should be used from the source of sea water to the storage tank. Lead-lined pipe is preferable if the salt water line to the storage tank is more than 300 or 400 feet long. This pipe should enter the *bottom* of the storage tank. The pump may be lined with stainless steel or with rubber. At this Laboratory a good cast iron pump has lasted 15 years and is still operating efficiently. It is advisable to have everything connected with the intake, pump, valves, and discharge into the storage tank of pure cast iron, for then there is no danger of electrolysis.

We use 3-inch intake from ocean to pump and 2½-inch pipe from pump to storage tank. Three to 5 h.p. is sufficient for such a pump for heads of 40–70 feet. If a larger pump is used, 5 or more h.p. is necessary, depending on the size. A pump running continuously can be used, but is not to be recommended. If the pump should lose its prime and the water remain off for a few hours, months of labor may be lost as a result of death to experimental animals. If a continuous pumping supply of water is used, a duplicate pump and motor are a necessity. Also, some type of stand pipe with overflow to maintain constant pressure is desirable, although regulation of a sort can be effected by the use of a valve or valves. Neither gate nor globe valves should be used here or in any other part of the system. Cast iron stopcock valves are much more efficient and last years longer. Any pump manufacturer will furnish engineering advice free.

Many types of alarm may be used with the system. We use a ½-inch overflow pipe coming out of the storage tank at just below full level, the pressure from the overflow tripping an alarm switch. Such a switch could be used on a float in the storage tank or in a stand pipe. A bucket-like trap that would fill and by its weight close a valve and also set off an alarm would be simple to make.

(3) Flushing may be illustrated by Fig. 1. By first opening valve 2 and then valve 1, water is allowed to flush the pipe from the storage tank to the drain (3). By closing valve 1 and starting the pump, the pipe from the foot valve through the pump is flushed out through the drain. By opening valve 1 and closing valve 2 with the pump running, the water being pumped is directed to the storage tank. All valves should be opened or closed easily to avoid water hammer. Either a good

foot valve should be installed at the point of intake and changed at low tide every two months or a short, flexible, rubber pressure hose should be used so that a change can be made at any stage of tide. It is necessary to have two foot valves so that one may be used while the other is being cleaned.

(4) One of the greatest mistakes made in salt water systems is the use of too large a storage tank. Salt water rots on standing, and the resulting chemical and pH changes are lethal, particularly to larval forms. If practically all of the stored water is used daily, the aquariums will remain sweet and the living material will flourish. If the storage tank is not too large, and if the pipe is flushed before pumping, the water will remain pure even though it is necessary to use a rather long cast iron pipe from the source of salt water to the storage tank.

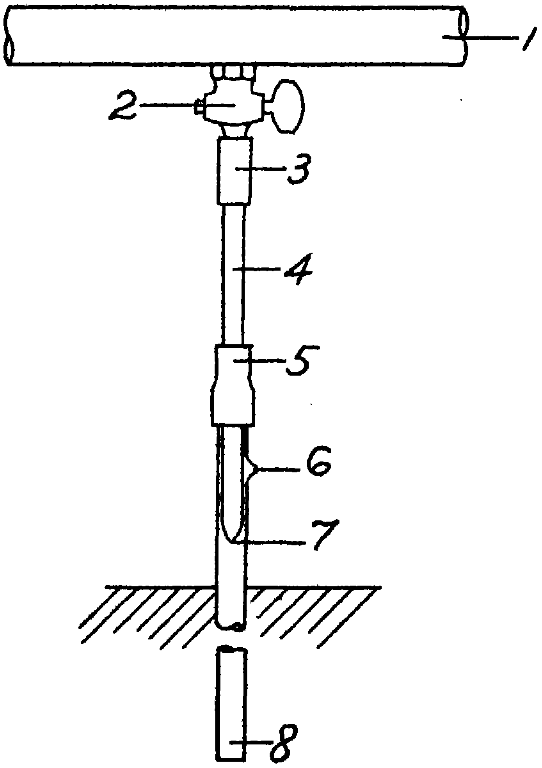

FIG. 2. Aerator for aquariums: 1, lead pipe over aquariums; 2, rubber stopcock; 3, rubber tubing connector; 4, glass tubing; 5, rubber tubing connector; 6, vent hole; 7, jet; 8, end of glass tubing near bottom of aquarium.

Organic material may be removed with filters, thus preventing some decay with its resultant ill effects, but these are expensive to install and keep up and are unnecessary if the above precautions are observed. Filters hold organic material which putrefies, and the products of decomposition wash through and contaminate the system.

Only slightly more salt water than will be used in the next 24 hours, more or less, should be pumped into the storage tank. Considering the location of most laboratories, that is, within a bay, water should be pumped just before or at high tide.

(5) Ten feet of head will provide ample force for aeration within the aquariums. After years of trial with many types of aeration devices, we use the rather simple setup shown in Fig. 2.

(6) *Thick-walled* lead pipe is most suitable, and less expensive in the long run, for conveying the sea water from the storage tank to the aquariums. Burning connections onto lead pipe can be done only by an expert workman and makes thin-walled pipe cost more than thick-walled pipe. This pipe need never be more than 2 inches in diameter; pipes to the separate aquarium tables, not more than ¾ inch in diameter. The largest pipe in our laboratory is 1½ inch. Carrying capacity varies as the square of the diameter; therefore, a 2-inch pipe will carry nearly twice as much as a 1½-inch pipe (all inside diameters).

Joints in the lead pipe are made by using bolt flanges and belling the lead over the sides to be joined together. Thus, when the flange bolts are tightened, lead comes against lead, and throughout the entire system from storage tank to aquarium tables, nothing but lead comes in contact with the sea water.

Thus far, most of the plastic pipe that we have experimented with has proved unsatisfactory for use with salt water. Some types seem to work fairly well after they have soaked out for a week or more, but the fact that they need soaking out is proof that, for some time, at least, they cannot be considered ideal. All trials with ordinary plastic garden hose have shown it also to be unsatisfactory. Some types we have tried quickly killed hardy marine animals after the pipe had been immersed in salt water for a week. We are now testing different plastics to determine if any are suitable for use in marine laboratories.

One-fourth inch hard-rubber outlet cocks, threaded with ¼-inch pipe thread, are best over the aquariums. These are easily installed. A nail set is driven into the lead pipe, the opening thus made being enlarged with a punch of the proper diameter for threading. This method builds a lip within the pipe which prevents the jet opening (Fig. 2) from plugging up with any bit of debris which may come in when the storage tank is filled.

(7) The better the system, the more growth, such as mussels, oysters, barnacles, etc., there will be within the lead distributing pipes. This cannot be killed with cold fresh water, because the animals close and remain so until sea water again comes in. Heat, however, will kill them quickly, especially if they are young. We connect a hose from the hot-water line in the laboratory to the outer end of each pipe over the aquariums and run water (90°C.) back through the pipe to the storage tank. This is done after draining the tank, so the hot fresh water drains to the outside. This flushing should be done at least once a month, preferably more frequently.

(8) When building the storage tank it is very important to be sure that its floor slopes from all sides to the combination drain and filling opening (Fig. 1).

A cement tank mopped inside with hot asphalt makes an excellent storage tank. The cement should be thoroughly dry before applying the asphalt, and after mopping it can be made to bond tighter to the cement by careful application of a blowtorch. Reinforcing should be kept well to the outside of the tank wall, for if sea water ever comes in contact with the reinforcing iron, rust will creep along it, necessitating a new tank.

Book Reviews

Geomorphology. (4th ed.) C. A. Cotton. New York: John Wiley, 1947. Pp. 505. (Illustrated.) $6.00.

This edition of Prof. Cotton's *Geomorphology* is essentially a reprint of the previous edition. A few minor changes in figures have been made.

For an elementary text the book is remarkably comprehensive, slighting practically no phase of geomorphology. Unfortunately, the author attempts to do two things in one book and does not quite succeed in either. The book is an attempt at a textbook on the geomorphology of New Zealand as well as, a general textbook in geomorphology. It is much more of the latter, but the illustrations are largely from New Zealand, and many landforms are specifically illustrated by reference to features in that country. This feature of the book will undoubtedly prevent it from being as widely used in this country as it merits. It is unfortunate that the illustrations could not have been given a more international flavor.

The book is a presentation of geomorphology from the Davisian viewpoint. Dr. Cotton follows Davis religiously in his terminology and concepts, especially in the development of the "normal cycle." A chapter presenting some of the ideas of Penck and others who do not subscribe to Davis' ideas would enhance its value as a textbook.

Allotment of space is rather well balanced. However, devotion of 11 pages out of 492 to a discussion of the work of groundwater seems hardly adequate. The treatment of glaciation, volcanicity, and the work of the ocean is, on the whole, superior to that of the average American text. As is customary in Dr. Cotton's books, *Geomorphology* exhibits clarity of expression and logical development of concepts.

William D. Thornbury

Indiana University, Bloomington

Kinetic theory of liquids. J. Frenkel. Oxford, Engl.: Clarendon Press, 1946. Pp. xi + 488. (Illustrated.) $13.00.

Although the fundamental principles are more or less settled, the quantitative development of the theory of the liquid state is still in an early stage. For this reason a book on the subject might seem premature. The circumstance that an understanding of the principles of the theory of the liquid state has thus far been restricted to a narrow circle of physicists and chemists and the fact that the presentation of a new theory, even in crude and incomplete form, may serve to attract the attention of other scientists and to accelerate its further development, led the author to undertake the task of writing this book.

The author has accomplished his task in a very competent manner. He has based his presentation on intuitively plausible models and has necessarily and wisely emphasized the physical aspects of the theory rather than its mathematical and logical aspects. He has drawn freely on the analogy between liquid structure and the structure of crystalline solids—an analogy which leads to the quasi-crystalline model according to which liquids, while lacking the long-range order of the crystal lattice, possess local structural order closely resembling that of crystals. The author makes extensive use of the theory of holes and of his own theory of heterophase fluctuations in his treatment of the equilibrium and nonequilibrium properties of liquid phases. He prefers, in general, the kinetic approach to that of the equilibrium theory of statistical mechanics, even in the treatment of equilibrium problems. He has in the main succeeded in his objective of constructing a coherent and physically satisfactory description of liquid structure and of phenomena occurring in the liquid state.

The book contains a critical and, in spite of some gaps, a remarkably complete survey of recent literature in the field. The author's comments on current work are sometimes sharply critical and open to debate, but they are always stimulating. The book can be recommended strongly to all workers in the field of chemical physics.

John G. Kirkwood

Cornell University, Ithaca, New York

Scientific Book Register

Baitsell, George A. (Ed.) *Science in progress.* (Fifth series, Sigma Xi National Lectureships, 1945–1946.) New Haven: Yale Univ. Press; London, Engl.: Oxford Univ. Press, 1947. Pp. xv + 353. (Illustrated.) $5.00

Danielli, J. F., and Brown, R. (Eds.) *Nucleic acid.* (Symposia of the Society for Experimental Biology, No. 1.) Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. vi + 290. (Illustrated.) $8.50.

Hogness, T. R., and Johnson, Warren C. *Qualitative analysis and chemical equilibrium.* (3rd ed.) New York: Henry Holt, 1947. Pp. xv + 553. $3.20.

Johnson, Maxwell O. *Shorter cycles in rainfall.* San Francisco: Phillips & Van Orden, 1947. Pp. 66. $3.00.

Luneburg, Rudolf K. *Mathematical analysis of binocular vision.* (Dartmouth Eye Institute.) Princeton, N. J.: Princeton Univ. Press, 1947. Pp. vi + 104. $2.50.

Macelwane, James B. *When the earth quakes.* Milwaukee, Wis.: Bruce, 1947. Pp. xi + 288. (Illustrated.) $5.00.

Pauling, Linus. *General chemistry: an introduction to descriptive chemistry and modern chemical theory.* San Francisco: W. H. Freeman, 1947. Pp. vii + 595. (Illustrated.) $4.25.

Potter, Ralph K., Kopp, George A., and Green, Harriet C. *Visible speech.* New York: D. Van Nostrand, 1947. Pp. xvi + 441. (Illustrated.) $4.75.

Smith, Alexander H. *North American species of Mycena.* Ann Arbor: Univ. Michigan Press; London, Engl.: Oxford Univ. Press, 1947. Pp. xviii + 521. (Illustrated.) $6.00.

Wolctoo, Albert B. *Catalogue of North American beetles of the family Cleridoe.* (Fieldiana: Zoology. Vol. 32, No. 2.) Chicago: Chicago Natural History Museum, 1947. Pp. 44. $.75.

The Isotope Distribution Program

Isotopes Branch, U. S. Atomic Energy Commission

ON JUNE 14, 1946, HEADQUARTERS OF the Manhattan Project first announced in *Science* a program for production and distribution of pile-produced radioactive isotopes for use in the Nation's scientific, technical, and medical investigations. On August 2 the first shipments of radioisotopes were made. On January 1, 1947, this program, with a fine record of five months of successful operation, was taken over, along with other operations of the Manhattan District, Corps of Engineers, by the U. S. Atomic Energy Commission.

With the passing of the one-year mark of isotope distribution it is appropriate that this journal, the official publication of the American Association for the Advancement of Science, should be the medium through which a report on the program is made. Numerous published technical articles have appeared on work achieved with distributed isotopes. A number of announcements on additional isotope distribution service have been published in the scientific journals, and popular releases on the uses of isotopes have appeared in the press and magazines. It has, however, been called to our attention by scientific and medical advisory groups that an occasional summary report of the over-all developments and accomplishments of the program should be published for the information of the Nation's scientific and technical personnel.

The Commission is indeed aware that it exercises a virtual monopoly in the distribution of many isotopes and that this distribution is now essential to a wide range of investigations and applications. The scientific importance of isotope distribution is evidenced by the report which follows. It is the intention of the Commission to press the program forward, within the provisions of the Atomic Energy Act of 1946, with a view to increasing benefit to scientific advance and human welfare.

DISTRIBUTION OF RADIOISOTOPES

During the first year of distribution, pile-produced radioisotopes were shipped to over 160 institutions and organizations, representing more than 240 departments and 500 groups located in 31 states and in the Territory of Hawaii. Users in four states (California, Massachusetts, New York, and Pennsylvania) account for nearly half the shipments (Table 1). In the first 12 months of the program over 1,100 shipments had been made.

If the recipients are divided into four main categories, the number of institutions in each is approximately as follows: medical institutions and hospitals (including medical schools), for use in therapy, diagnosis, and research, 60; educational institutions (mainly universities), for use in research, 50; industrial and profit organizations, for use in both fundamental and applied research, 35; public and private nonprofit research institutions (other than educational), for use in fundamental and applied research, 20.

TABLE 1

DISTRIBUTION OF RADIOMATERIALS BY LOCATION

(First 12 Months—to July 31, 1947)

State	No. of institutions	No. of shipments
New York	26	153
California	16	104
Pennsylvania	15	66
Massachusetts	13	169
27 other states and Hawaii	90	609
Total	160	1,101

About 60 different radioisotopes were shipped—a major portion of available kinds. In Table 2 are shown data on the total number of shipments in each of several major categories of available isotopes. Fission products have been grouped as one entry, as have most of those radiomaterials furnished without chemical processing (*i.e.* in "irradiated units" of the target material). P^{32} and I^{131}, used chiefly in medical diagnosis and therapy, constitute the largest number of shipments of chemically separated radioisotopes. These two also account for the largest total activity shipped in the form of separated isotopes (over 10,000 millicuries each). It is particularly noteworthy that the first year's distribution included over 90 shipments of C^{14}, with a total activity of about

TABLE 2

DISTRIBUTION OF RADIOMATERIALS BY ISOTOPES

(First 12 Months—to July 31, 1947)

Radiomaterial	No. of shipments
C^{14} (separated)	99
P^{32} (separated)	261
$P^{32}\left\{\begin{array}{l}\text{unseparated}\\\text{in sulfur}\end{array}\right\}$	1
P^{32} (in phosphate)	52
$I^{131}\left\{\begin{array}{l}\text{unseparated}\\\text{separated}\end{array}\right\}$	313
I^{131} (in tellurium)	9
S^{35} (separated)	12
$S^{35}\left\{\begin{array}{l}\text{unseparated}\\\text{in chloride}\end{array}\right\}$	22
10 isotopes of fission products (separated)	17
40 isotopes in irradiated units (unseparated from target materials)	307
Service irradiations	8
Total shipments	1,101

130 millicuries. This quantity of the extremely important isotope, C^{14}, is millions of times greater than that heretofore available for investigations.

USES OF DISTRIBUTED RADIOISOTOPES

Hundreds of different uses are being made of distributed radioisotopes. The number of individual phases of investigation being undertaken is difficult to estimate but is certainly over 1,000.

The types of investigational problems in progress with the distributed radioisotopes are as varied as the interests and imaginations of the investigators. Most of the studies could not be approached satisfactorily, if at all, in any other way. It is not appropriate here to attempt to list or discuss the many types of uses. A general discussion and a few specific cases will, however, be enlightening.

From a functional standpoint, uses of radioisotopes may be classed as follows: tracer investigations (including medical diagnosis), medical therapy, sources of radiation for physical applications (radiography, etc.), and studies of nuclear properties and phenomena. The first two types of uses far outweigh the others in number and importance. As noted above, a fairly large number of medical institutions are using radioisotopes for medical therapy, diagnosis, and research. Tracer investigations, of course, promise a vast extension of knowledge in many fields, and their ultimate value to human welfare may far exceed that of the other applications of isotopes.

From the standpoint of fields of investigation, the uses of radioisotopes can be classified roughly into 9 groups, although most of the work has been done in the fields of medical therapy and physiology (animal and human). Agriculture, plant physiology, industrial research, chemistry, and physics account for most of the remainder, with lesser amounts of work being done in microbiology (bacteriology) and metallurgy. Many specialized phases related to the above fields are represented, such as animal husbandry, biochemistry, dentistry, entomology, industrial hygiene, petroleum engineering, pharmacology, radiology, soil science, surgery, toxicology, veterinary medicine, and zoology.

An appreciation for the scope of radioisotopes as tracers in biological and medical research can be gained from the following list of some of the biological materials that are being labeled and traced: alcohols, amino acids, antigens, bacteria, bile acids, blood cells, carbohydrates, carcinogens, enzymes, fats, fatty acids, hormones, insulin, nucleic acids, penicillin, pharmaceutical agents, proteins, starches, sulfa drugs, tissue fluids and salts, viruses, and vitamins. The synthesis, utilization, and excretion of such labeled materials are studied in the organs and tissues of a wide variety or organisms (plants, animals, and man).

Therapy of hyperthyroidism and certain thyroid cancers with I^{131} has been employed rather extensively as has that with P^{32} in the treatment of polycythemia vera and other blood dyscrasias. One laboratory has extensively tested the therapeutic value of colloidal radiogold (Au^{198}) in cases of lymphoid malignancy. Several others are testing the efficacy of certain radioisotopes in beta-ray applicators and in colloids for treatment of local lesions.

I^{131} has been used in studies of the fundamental metabolism of the thyroid gland. A considerable number of workers are attempting to elucidate the mechanism of both carbohydrate and protein metabolism by use of compounds labeled with C^{14}. A variety of problems, including those of bone and tooth formation, have been attacked by using radiocalcium and radiophosphorus. Radioiron is being used in studies of blood function, and radiosodium has been employed in the study of water balance and blood flow.

Of all the studies in plant physiology the most dramatic is probably the effort to learn the mechanism of photosynthesis by use of C^{14}, but others have initiated studies to increase our knowledge of the absorption by plants and animals of phosphorus, calcium, iron, potassium, and some trace elements by using the appropriate radioisotope in each case.

Many other studies related to agriculture are in progress, including storage in soil and uptake by crop plants of fertilizers and other soil additives; action of insecticides, fungicides, and weed killers on insects, plants, and animals; effects of industrial vapors and wastes on plants and animals; deficiency diseases and utilization of foods and essential minerals in crops and livestock.

In chemistry the principal emphasis has been on the use of labeled molecules in the study of reaction and exchange mechanisms. A similar effort is being made in certain industrial research work, notably in the field of catalysis in hydrocarbon reactions.

Physicists have used a goodly number of radioisotopes in their effort to arrive at more exact measurements of disintegration patterns.

A unique approach to the industrial hygiene problem of removal of air-borne toxic and infectious materials has been made possible by studying the capacity of filters and exhaust systems to remove finely atomized radioactive materials of short half-life.

Increasing applications are being made in industrial problems. These include investigations on friction, lubrication, diffusion, aging and oxidation of metals, kinetics of reactions in solid alloys, control of impurities in metal melts, petroleum cracking, oil field logging, and chemical process efficiencies.

IMPROVEMENTS IN AVAILABILITY OF RADIOISOTOPES

The initial announcement on the availability of pile-produced radioisotopes listed 80 procurable radioisotopes. It was emphasized in the announcement that none of the radioisotopes was yet in routine production. For a few isotopes only, production processes were under technical development. For most isotopes, processes were largely in the research or then untried stages.

During the elapsed year, Clinton Laboratories, Oak Ridge, Tennessee, the supplier, has achieved much progress in routine production of many items and has made significant improvement in the form and availability of those materials not yet in routine production. Production of the majority of items is now adequate to meet the legitimate demands of all users who can handle the materials effectively and safely. In addition, it has been possible to add 16 procurable radioisotopes to the list originally released to *Science*.

Investigators may also now secure service irradiations of their own materials when necessary. Special chemicals and other materials (suitable for exposure in the Clinton pile) may be subjected to pile irradiation. This enables qualified personnel to study the effect of pile irradiation on crystals, organic chemicals, seeds, intact metal parts, and numerous other materials of special interest. The Argonne National Laboratory, Chicago, Illinois, has also recently undertaken to perform certain service irradiations for qualified investigators by means of the Argonne heavy-water pile.

Improved and large-scale methods of producing C^{14} have permitted a significant reduction in the cost of this important item from $367 to $50 per millicurie.

Chemically separated S^{35} of high specific activity has been made available in the form of labeled H_2SO_4 and Na_2S. Increased yield in extraction of S^{35} (from irradiated chlorine compound) has also made possible lower prices on these items.

Improvements in the processes of extraction of P^{32} and I^{131} (from irradiated sulfur and tellurium, respectively) now enable the supplier to meet more rigid specifications on the chemically separated forms of these isotopes. This is important, since the materials are being extensively used in medical investigations on human beings, both in diagnosis and therapy.

Small quantities of chemically separated Ca^{45} of high specific activity have just become available. This isotope is produced by transmutation reaction in scandium. When extraction procedures have been developed further, the material should become routinely available.

Some of the important tracer radioisotopes, such as radioiron, radiocalcium, and radiochlorine, originally available only with low specific activity, are now being made available with much higher specific activity.

C^{14}-labeled compounds (other than $BaCO_3$) are being prepared by several Commission laboratories for their research programs. However, excess quantities of certain compounds can be synthesized for use by laboratories outside the Commission. C^{14}-labeled methanol (C^*H_3OH) is currently available, and C^{14}-labeled barium carbide and sodium formate should be available soon. Additional C^{14}-labeled compounds, useful largely as intermediates, are expected to become available also.

AVAILABILITY, DISTRIBUTION, AND USE OF STABLE ISOTOPES

During the 7 months that the distribution program has been under the control of the Atomic Energy Commission, enriched forms of three stable isotopes have been made available. Heavy hydrogen is available as deuterium gas and heavy water, in which the ratio of the hydrogen isotopes is 99.8 deuterium to 0.2 protium. Boron is available in calcium fluoride-boron fluoride complex containing B^{10} concentrated to 96 per cent of the boron content (or about 5-fold enrichment of B^{10}). O^{18}, with a concentration about 7 times that in nature, is available in water in which the deuterium is not enriched.

Since the May 1, 1947, announcement of deuterium distribution, over 75 research groups in all parts of this country have been allocated an equivalent of about 28,000 grams of deuterium oxide. Lower price and greater availability of the material are permitting extensive and new uses of deuterium. Studies that were previously unfeasible are now being made in humans.

The deuterium or deuterium oxide is being used to supply bombarding deuterons for cyclotrons and other nuclear accelerating devices at 18 research institutions. Other applications in physics include: absorption spectra of deuterium-substituted inorganic and organic compounds; piezoelectric property of deuterium-containing crystals; photodisintegration of deuterons; filler for high-pressure cloud chambers; calibration of mass spectrometers; and molecular moment studies.

In chemistry deuterium is being employed to synthesize substituted compounds such as deuterium-labeled benzene, aliphatic hydrocarbons, and halogenated fatty acids, which are studied for their physical and chemical properties. The mechanisms of certain chemical reactions are very easily investigated with heavy hydrogen.

Deuterium is also serving as a tool in many biological and medical investigations. Biosynthesized tyrosine being labeled with deuterium will be used to study the metabolic aspect of this material. Studies of total body water and extracellular fluids in various physiological conditions of the human body are being made with heavy water, as are metabolism studies involving amino acids, bile acids, fatty acids, tryptophane, glycogen, nicotinic acid, etc.

Eleven leading institutions conducting nuclear research have received allocations of the complex containing B^{10}. Although B^{10} is being used chiefly in the preparation of ionization chambers and counters for neutron detection, some investigators indicate that studies of nuclear reactions of B^{10} will be made.

Since distribution of O^{18} has only recently been announced, no report is made on this item. Because of the relatively low enrichment of the material, it will in most cases be enriched further before use by several groups who have set up equipment suitable for the purpose.

HEALTH PROTECTION

Radioisotopes will perhaps find their greatest application when employed in small quantities as tracer substances rather than in large quantities as therapeutic or industrial agents. However, because of the radioactivity involved, any application requires certain fundamental knowledge for effective and safe use of radioisotopes.

Information on health protection is one of the most frequent requests received in connection with the program. Several circulars on health protection are available, and further informational circulars on medical and health protection measures are being prepared for distribution to radioisotope applicants and users.

For practical purposes, health protection may be considered as presenting two individual but related problems. The first, which is largely medical, consists of determining experimentally the biological effects of radiations and radioactive materials and of checking for possible radiation effects in the body. This is essential for the safeguarding of personnel using radioactive materials. Experiments are being conducted, and the results being made known, on the toxicity and radiation effects which may be produced by a wide variety of radioisotopes. Although we now have certain indices which are of value, improved methods of detecting possible radiation effects are continually being sought.

The second problem is largely physical and bears a causal relationship to the first. It is known as "health-physics." By this term we connote all those precautionary measures of routine monitoring, adequate shielding, handling techniques, decontamination, etc. which serve to avert any excess exposure to radioactivity. Research and development is under way to improve such measures.

ADVISORY FIELD SERVICE

In view of the general need for health protection assistance in the use of radioisotopes, the Atomic Energy Commission has established, in conjunction with the distribution program, an Advisory Field Service. When a specific need for this service is indicated, it is provided to isotope users without charge. Its prime objective is to render assistance, information, and consultation on all matters of health protection. When feasible, it will attempt to advise and make available information on new techniques of measurement and application.

The service, which functions through the Isotopes Branch, now has a physician and health-physicist available for consultation. Although the service is at present limited to those in most need of it, it may be expanded as deemed necessary.

INSTRUMENTATION

During the war, manufacturers of radiation-measuring instruments diverted their entire production to wartime needs. The Manhattan Project was the largest single customer. The Atomic Energy Commission still requires a large number of the produced instruments to continue its work most effectively. Instrument-manufacturing companies, which now include many new firms, are, however, becoming increasingly able to meet demands from the open market.

Most types of radiation instruments developed on the Manhattan Project have been declassified and are already, or soon will be, commercially available. The Commission is continuing with vigor the policy of licensing for commercial production and sale those radiation instruments developed within its facilities. Commercial firms have also undertaken considerable development in instrumentation. Increasing availability of many types of improved radiation-detection instruments is therefore expected. The Isotopes Branch, upon request, will furnish lists of manufacturers and offer assistance concerning types of radiation instruments which will facilitate an investigator's work.

DECLASSIFICATION OF PERTINENT INFORMATION

Of the many Commission research reports written in connection with the development of atomic energy, three types—those on medical, health-physics, and instrumentation matters—are of special interest to the users of radioactive isotopes. Authors of reports falling in these categories are being encouraged to submit them for declassification, and to date more than 125 such documents have been declassified. A large number of these reports are available to the public through publication in widely circulated scientific journals. Copies may also be obtained through the Office of Technical Services of the U. S. Department of Commerce.

PROCUREMENT

The situation is good for procurement of most isotopes offered by the Commission. The stocks of stable isotopes are adequate for most uses. (C^{13} and N^{15} are not procurable from Commission facilities, but are obtainable in good supply from commercial firms.) Many of the chemically separated radioisotopes are produced regularly to keep supplies currently available. Other radioisotopes are separated in batches as demands arise. Radiomaterials furnished without processing are usually produced only after receipt of a purchase order by the supplier. A week to several months is then required, depending on the isotope desired. Details concerning availability and procurement of isotopes and related information and services may be obtained by writing the Isotopes Branch, Atomic Energy Commission, P. O. Box E, Oak Ridge, Tennessee.

The Isotopes Branch serves as an information and allocation agency, while production and distribution are accomplished by organizations under contract with the Commission. Submission of purchase orders and arrangements with the supplier concerning specifications and shipments of materials are made only after allocation. Allocations can be obtained in one to three weeks after submission of properly completed request forms, the time depending on action that may be necessary by advisory allocation groups.

Although it is not possible in this limited space to give due credit to all individuals who have contributed to the success of this program, it is possible to designate certain organizations and groups which have made enormous contributions.

The Clinton Laboratories pile has been chiefly responsible for the production of radioisotopes, although piles of other areas have been used to some extent.

The preparation of chemically separated radioisotopes has been accomplished through the cooperative activities of the Chemical, Technical, and Production Divisions at Clinton Laboratories, operated for the Government by the Monsanto Chemical Company.

The Chemical Division at Clinton Laboratories and various groups at the Argonne National Laboratory and Radiation Laboratory of the University of California have made numerous contributions to basic radiochemical and physical techniques which aided the development of presently employed processes.

Matters pertaining to scheduling, shipping, and billing have been efficiently handled by the management and other groups at Clinton Laboratories. The Health-Physics Department there has given expert supervision to the safety and health protection phases of packaging and shipment.

Production of deuterium gas from deuterium oxide as well as the shipping and billing for the produced gas and deuterium oxide are being managed by Stuart Oxygen Company, San Francisco, California. The deuterium oxide was produced by facilities contracted for by the Manhattan Project.

Allocations by the Atomic Energy Commission have been made by the Isotopes Branch with the assistance of advisory committees composed of personnel outside the Commission staffs. Each request has been reviewed and rated on its individual merits by subcommittees on allocation and on human applications. These advisers are as listed in the original announcement in *Science*. Their continuing service, which is voluntary, is indeed keenly appreciated.

The success attained in the isotope distribution program has been the result of cooperation of a number of organizations and hundreds of interested persons. The Commission appreciates the fact that it can rely on the continued cooperation and efforts of these individuals, as well as on further participation by others. Increasing success of the program is therefore guaranteed.

Suggested Principles of "Social Physics"

John Q. Stewart
Princeton University Observatory, Princeton, New Jersey

A NEW DEMOGRAPHIC INDEX, CALLED "potential of population," was found in 1940 (*1*). Studies have been resumed, and it is now established that, when averages are considered, principles resembling some of those of physics apply not only in demography but in related aspects of economics.

When celestial mechanics was being developed, in the 16th and 17th Centuries, the order of advance was: (1) the collection of quantitative observations (Tycho Brahe); (2) their condensation into empirical mathematical regularities (Kepler); and (3) theoretical interpretation of the latter (Newton). If there is to be a social physics, its beginnings must follow the same standard pattern. During recent years, social statisticians have published amazing amounts of numerical observations. That stage is well advanced. Several pioneers (especially G. K. Zipf and A. J. Lotka) have described significant empirical regularities. A great deal more attention must, however, be given to the third stage by numerous investigators before it is fully achieved.

Mathematical rules in demography are described in a current report (*2*) which contains numerous references to previous work. Intensive further studies have been carried on with the cooperation of the School of Economics and Politics of the Institute for Advanced Study. Only a partial and condensed description of these can be given below.

An important empirical relation is found between the population and the average area of cities in the U. S. Census of 1940, namely,

$$A = \frac{P^{\frac{3}{4}}}{350},$$

the area, A, being in square miles. This is the land area of the "political" city, within the official city limits. The rule holds statistically for cities above the rural limit of 2,500, including the largest ones. Examination of less inclusive data published by the Bureau of the Census for 1890 shows that the same formula applied, except that the numerical constant was 400 instead of 350. That is to say, a city of any assigned population averaged no more than 6 or 7 per cent larger in linear dimensions in 1940 than in 1890, notwithstanding the development of rapid transit.

The existence of this conspicuous regularity demands the existence of additional ones in the average distribution of people within each city. For each of 60 leading cities in 1940 the internal distribution of population by "census tracts" is available. There is strong evidence for the following standard internal pattern, as a first approximation: *The normal city, regardless of size, has roughly the same density of population at its edges, averaging there about 3 people per acre or 2,000 per square mile. From edge to center, the density tends to increase exponentially with the distance, reaching a peak density in some inner census tract which usually is adjacent to others having densities nearly as great. The peak density tends to increase with the size of the city, reaching in 1940 more than 400 per acre in Manhattan (Avenues B to D, 3rd to 9th Streets).*

The "demographic gravitation" implied by various applications of the concept of potential of population serves to account in part for these facts. But a statistical countertendency is required to explain why all the people in a city do not pile up in the most dense census tract. An adequate mathematical description of this appears to be found in the concept of the "human gas." Each individual seeks some elbowroom or living space. The idea of a two-dimensional gas is already familiar in physics (monomolecular layers). In the demographic analogue we write: pa = NT, where a is the area occupied by N individuals (molecules), p is the "demographic pressure," and T is the "demographic temperature." In the physical case, p is the force per unit length of boundary.

Since the well-to-do normally live in larger quarters than the poor, the use of per-capita rent suggests itself as a measure of demographic temperature. This, in turn, following obvious physical analogues, leads to the interpretation of the "demographic energy," NT, as value or wealth. The quantity T can be measured by the value per capita of the land plus improvements, while p is its value per unit area. In general, the "demographic force" is interpreted as the rate of change of a value with distance.

The high land-value per acre reached in cities is a consequence of demographic gravitation. People gather in urban concentrations because both the means of livelihood and the material services which enhance living can be more varied and abundant in such situations. The suggested combination of gravitation and the gas laws is already a familiar pattern in astrophysics, in the elementary theory of stellar constitution.

Confirming the above ideas, a relation at once follows to the previously observed average dependence of the density of rural population on the potential of population (*1*). Not only in 1930, but also in 1940, 1900, and 1840, the rural density in the United States tended to vary as the square of the potential. Cities are "anchored" in place by special considerations (often topographic), but *the rural population can distribute itself with relatively little distortion by sharply local influences*. In order for the density of a perfect gas to vary as the square of the gravitational potential, the temperature, as can easily be shown, must vary as the potential. Full data concerning rents are available in the Population and Housing series of the U.S. Census of 1940. It is a fact that in the 28 states east of Colorado and north of the Deep South—where the rural density rule held especially well—the rural nonfarm rent was, on the average, proportional to the first power of the potential of population.

This result leads to a dollar quotation (or conversion factor) for the demographic unit of value—the value of the propinquity of two people placed one mile apart, as evidenced in the value of land. It was of the order of half a cent in 1940, in terms of capitalized rural rent.

A rough survey of rural land values at different times and different places in the United States suggests that the *dollar quotation of the unit of propinquity has been much less unstable than the cost of living*. Indeed, the speculative suggestion may be made that the secular increase in the latter has not been produced by inflation in the value of the demographic unit, but by the continued growth of population. That has increased the number of units of propinquity involved in normal subsistence.

Just as the telephone subscriber on a large exchange must pay more because he can make more different calls than the subscriber on a small one, so the individual in the United States of the present is involved in many more possible relations with his fellows than when our population was smaller. The number of relations of N_1 people who are at a distance d from N_2 people is proportional to N_1N_2/d; this is the demographic energy. The introduction in this formula of the factor of inverse distance agrees with common sense, but its final justification is found in a large variety of statistical evidence in the social field.

References

1. Stewart, John Q. *Science*, 1941, **93**, 89–90.
2. Stewart, John Q. *Geogr. Rev.*, July, 1947.

Association Affairs

Meeting of Southwestern Division

The first postwar meeting of the Southwestern Division, AAAS, was held in Colorado Springs, May 1–3, in conjunction with the Colorado-Wyoming Academy of Science. Societies meeting in association with the Division were the Clearing House for Southwestern Museums, the Colorado-Wyoming Chapter of the American Association of Physics Teachers, the Colorado-Wyoming Social Science Association, the Rocky Mountain Branch of the American Psychological Association, the New Mexico Academy of Science, and the Colorado College Chapter of the American Association of University Professors. Colorado College served as host institution, all the meetings being held on its campus.

A total of 158 papers covering a wide field of effort were presented in the 11 sections as follows: Bacteriology, 9; Plant Science, 30; Zoology, 16; Anthropology-Archaeology, 6; Education, 4; Psychology, 15; Social Science, 4; Chemistry, 25; Geology-Geography, 33; Physics, 13; and the American Association of Physics Teachers, 3. A comparison of the total of 350 officially registered scientists with the 158 papers presented shows that many persons attended only to listen and learn. This feature of educating the nonspecialist to what the researcher is doing is often overlooked by those presenting papers. All too frequently the speaker, no doubt because of time limitations, starts off in the middle of the subject, assuming equal familiarity with his specialty on the part of his listeners. The result is that no one is educated except specialists in his own field.

It may well be assumed that many who present papers at scientific meetings would not attend if they were not on the program, since their papers, if real contributions to science, would eventually be published and made available to scientists generally. One frequently hears the comment that because scientific sessions are too technical to be understood it is unnecessary to attend them, and that the chief value in attendance lies in the people one meets and talks to in the corridors. If this is true, more attention should be given to demanding that papers submitted for presentation be truly informative to the nonspecialist, to keeping the number of papers down, and to giving each speaker sufficient time not only to present new facts but also to lay a foundation for his subject. At present it is difficult to find cities willing and able to serve as hosts to large conventions. Would it not be wise to reduce the number of papers, require that they be truly informative, and thus bring science to the community in which the meeting is being held?

A high light of the meeting was the annual John Wesley Powell Lecture, delivered by John H. Manley, executive secretary of President Truman's General Advisory Committee to the U. S. Atomic Energy Commission, and a former head of the research division, Los Alamos Scientific Laboratory. His address was entitled "One Atom and Many."

The address of the retiring president, H. P. Mera, given following the annual dinner, was entitled "Archaeological Research in the Southwest." This stressed the importance of using the findings of archaeological research to guide future actions of man in order to avoid the catastrophes causing the disappearance of previous civilizations. He warned against a mere multiplication of findings of things already known by excavations of sites similar to those studied by previous workers.

Officers elected were: F. H. Douglas, Denver Art Museum, president; Ernst Antevs, Globe, Arizona, vice-president; H. P. Mera, Santa Fe, and Edna L. Johnson, Boulder, members of the Executive Committee. An invitation from President Edward Eyring, New Mexico Highlands University, to meet in Las Vegas, New Mexico, in 1948 was accepted. A second Alpine Texas meeting for 1949 was also approved following invitations from President R. M. Hawkins, of Sul Ross State College, and Otto Struve, honorary director, McDonald Observatory. The 1949 meeting will be especially interesting, since various societies in Chihuahua, Mexico, have joined in the invitation and assured us of their cooperation, offering to serve as hosts for an excursion into Old Mexico after the formal sessions. The first Alpine meeting was held in 1939 on the occasion of the dedication of the McDonald Observatory on Mt. Locke, at which time both the college and the observatory served as hosts.

At the conclusion of the meeting guests joined excursions offered to study "The Geology of the Pikes Peak Region," "The Manitou Experimental Forest," or "The Watersheds East and North of Colorado Springs." (FRANK E. E. GERMANN, Executive Secretary-Treasurer, Southwestern Division.)

Meeting of Pacific Division

The 28th annual meeting of the Pacific Division, AAAS, was held in San Diego, California, June 16–21, 1947, with 970 registered members and guests in attendance. This, the second San Diego meeting of the Division, was held at the invitation of the San Diego Council of Technical and Scientific Societies, Society of Natural History, State College, and Zoological Society, the Scripps Institution of Oceanography, the U. S. Navy Electronics Laboratory, and 11 other scientific and technical organizations and institutions in the area. Headquarters were established at the U. S. Grant Hotel, and meetings were held there and at the San Diego Hotel, in the Chamber of Commerce Auditorium, at San Diego State College, and in church and school auditoriums.

The general sessions began on the afternoon of June 16 with a symposium on "The Pacific Basin." K. O. Emery spoke on "The Submarine Geology of Bikini Atoll," H. U. Sverdrup took as his topic "Oceanography and Meteorology," and J. L. Kask discussed economic and international aspects of the Pacific fisheries under the title "Who Harvests the Pacific?"

At 4:30 P.M. a reception for members of the Association and associated societies and their guests was held in the Palm Court of the U. S. Grant Hotel.

The symposium on "The Pacific Basin"

was continued on Tuesday morning with papers by E. B. Copeland, on "Origin of the Native Flora of the Pacific Islands"; R. L. Usinger, on "Wartime Dispersal of Pacific Island Insects"; and F. W. Hartmann, on "Public Health Problems in the Pacific Islands." At the conclusion of the Tuesday morning session, Chairman K. A. Ryerson, of the Pacific Science Board, reviewed the plans of the Board for the promotion and coordination of research in the Pacific area, especially in the islands taken over by the United States during the war.

The address of T. G. Thompson, retiring president of the Pacific Division, was given Tuesday evening on the topic "Research." Prof. Thompson spoke particularly of the importance of research to the national defense and of the need of a more comprehensive plan for the mobilization of scientific talent and scientific resources.

On Wednesday evening L. A. DuBridge, president, California Institute of Technology, dealt with the reciprocal of this theme in a lecture on "Radar and Its Peacetime Uses."

The concluding evening address was given Thursday by G. L. Clarke, of Harvard University and the Woods Hole Oceanographic Institution, on "Light and Life Within the Sea."

Roy E. Clausen, of the University of California, Berkeley, was elected to the presidency of the Division, succeeding Prof. Thompson. H. S. Reed continues as vice-president and chairman of the Executive Committee. R. C. Miller was reelected secretary for a three-year term. W. A. Clemens was elected a member of the Executive Committee for a five-year term, and W. Weniger and G. E. Goodspeed, members-at-large of the Council for four-year terms.

A resolution was adopted endorsing the Fulbright Law (*Science*, May 9, p. 483) and urging that, in view of the predominant interest of other countries and governments in science and the value of scientific relations in building world peace, at least three of the 10 appointees to the Board of Foreign Scholarships be men prominent in the natural sciences. This resolution was telegraphed to the President of the United States. A further resolution was adopted urging the removal of all restrictions on exchange of scientific publications between the United States and Japan.

A resolution was adopted expressing to the local committee and the host institutions and organizations the appreciation of the officers and members of the Pacific Division and associated societies of the excellence of the facilities provided and the cordial hospitality extended this scientific gathering.

Three additional organizations, the Herpetologists League, the Meteoritical Society, and the Oregon Academy of Science, were elected to the status of associated societies of the Division.

The following societies meeting in conjunction with the Pacific Division held programs for the reading of scientific papers: American Chemical Society (Pacific Intersectional Division), American Meteorological Society, American Phytopathological Society (Pacific Division), American Society for Horticultural Science (Western Section), American Society of Ichthyologists and Herpetologists (Western Division), American Society of Plant Physiologists (Western Section), Association of Pacific Coast Geographers, Astronomical Society of the Pacific, Botanical Society of America (Pacific Division), Ecological Society of America (Western Section), Herpetologists League, Institute of Mathematical Statistics, Meteoritical Society, National Science Teachers Association (Western Area), Oceanographic Society of the Pacific, Society of American Bacteriologists (Southern California Branch), Society for Experimental Biology and Medicine (Pacific Coast Branch and Southern California Branch), Western Psychological Association, Western Society of Naturalists, and Western Society of Soil Science.

Action was taken to accept the invitation of the University of California to hold the next annual meeting of the Division on the Berkeley campus, June 21-26, 1948. (ROBERT C. MILLER, Secretary, Pacific Division.)

Advance Registration and Hotel Headquarters Assignments

Those planning to attend the Chicago Meeting of the AAAS, December 26-31, may register now by sending the correct fee ($2.00 for members and college students, $3.00 for nonmembers) to the Washington Office of the Association, 1515 Massachusetts Avenue, N.W. Those registering before December 1 will receive a copy of the *General Program* well in advance of the meeting, will save themselves the time of registering during the meeting, and will have their names included in the special directory of registrants which will be available for inspection in all the headquarters hotels.

The *General Program* will list the papers of the sections and societies meeting with the Association, including the time and place of each session. It will also contain announcements regarding general sessions, the International Science Exhibition, eating facilities, transportation, mail and messenger service, and a directory of speakers and presiding officers. Readers will find the Summary of Sessions a most useful adjunct.

Registration fees will be accepted for mail distribution of the *General Program* until December 10. Payments received after this date will be held and placed on file on December 26 at the main registration center, located adjacent to the Exhibition in the Stevens Hotel. Upon identification, these registrants will be given a copy of the *General Program*, and their registration cards will be placed in the Visible Directory. To avoid delay in receipt of copies of the program during the Christmas mailing rush, registration fees should reach the Washington Office before December 1.

Scientific Exhibits

Plans for many fine scientific exhibits demonstrating research progress and techniques in varied fields are progressing rapidly. A special exhibit being prepared by a group of the 1946 Nobel Prize winners will show the research for which each scientist was honored. Other exhibits scheduled include: "Radar Charting on the Ohio River," prepared by the Louisville Engineer District Corps of Engineers, U.S.A.; "Magnetic Expiration in the Antarctic and Arctic Alaska," by the Division of Electricity and Magnetism, Naval Ordnance Laboratory; "Hydrocarbon Research and Electronic Miniaturization," by the National Bureau of Standards; "Progress in the Art of Prosthetic Devices," by the Veterans Administration; "Bulbar Poliomyelitis and Epidemiology and Diagnosis of Infantile Paralysis," by the National Foundation for Infantile Paralysis; and "Anatomic Specimens Embedded in Plastics," by Otto F. Kampmeier, University of Illinois College of Medicine.

Arrangements for technical exhibits by a large number of commercial organizations have already been made since the first announcement in *Science*.

NEWS
and Notes

Loren C. Eiseley, head, Department of Sociology and Anthropology, Oberlin College, Oberlin, Ohio, has resigned to become professor of anthropology and chairman, Department of Anthropology, University of Pennsylvania.

Charles H. Brown, director of the Iowa State College Library for 24 years, has recently been honored by the Association of College and Reference Libraries. A special July edition of the Association's publication, *College and Research Libraries*, contains papers assembled as "a testimony to the energy and productiveness of one of America's outstanding librarians." Under his direction the Library grew from 90,000 volumes, scattered about the campus, to a 370,000-volume centralized institution. An article on scientific publishing in Europe, which reflects Dr. Brown's interest in library cooperation and rehabilitation both here and abroad, appeared in the July 18 issue of *Science*.

Salvatore P. Lucia, associate professor of medicine and chairman Subdivision of Preventive Medicine, University of California Medical School, has been promoted to full professor of medicine.

Walter C. Russell, executive secretary, Graduate Faculty, and professor of agricultural biochemistry, Rutgers University, was awarded the honorary D.Sc. degree by Ohio Wesleyan at its recent commencement.

James F. Ferry, West Virginia University, has been appointed associate professor of botany, Louisiana Polytechnic Institute.

William F. Hughes, Jr., former associate at Indiana University, has been named professor and head, Department of Ophthalmology, University of Illinois College of Medicine, Chicago.

Alan Andrew, teaching assistant and former research staff member of the rocket project at California Institute of Technology, has been named assistant professor of physics at Pomona College, Claremont, California, for the coming year.

Rupert Wildt, assistant professor of astrophysics, Yale University, and **Donald H. Menzel**, professor of astrophysics, Harvard University, have been invited to attend a conference on "The Relations Between Solar Phenomenon and Geophysics" at Lyon, France, September 1–7. This is one of a series of international scientific meetings being organized by the French National Center of Scientific Research with the aid of the Rockefeller Foundation.

Oscar Riddle, Carnegie Institution, retired, has been elected to honorary membership in the Physiological Society of India and in the Facultades de Medicina, Farmacia y Química, San Carlos University, Guatemala, and to fellowship in the Sociedad Mexicana de Historia Natural.

C. M. Louttit, who recently resigned as dean of faculty, Sampson College, has been appointed professor of psychology and dean, Undergraduate Division, University of Illinois, Galesburg.

Hans G. Schlumberger, Western Reserve Medical School, has been appointed to the staff, Department of Pathology, Ohio State University, where he will investigate cancer in animals, particularly fish and frogs, and study the transmissibility of the disease and cancer cell growth in these animals.

Howard J. Curtis, associate professor of physiology, College of Physicians and Surgeons, Columbia University, has been appointed head, Department of Physiology, Vanderbilt University School of Medicine, succeeding **Glenn A. Millikan**. During the war, Dr. Curtis served as director of biological research at Oak Ridge, Tennessee.

Leslie E. Card, professor of poultry husbandry, University of Illinois College of Agriculture, has been named head of the Department of Animal Science (formerly Animal Husbandry), succeeding **William E. Carroll**, who has been appointed associate director of the Agricultural Experiment Station.

Visitors to U. S.

Louis Van den Berghe, Institute of Tropical Medicine, Antwerp, Belgium, and a member of the staff, Institute for Scientific Research in Central Africa, was a recent visitor at the University of Texas Medical Branch, Galveston, for a conference on chemotherapy of tropical diseases, at which he reported on the use of Bayer 205 in certain filarial infections. Dr. Van den Berghe has also visited the University of California Medical Center, San Francisco, and other American institutions interested in tropical medicine.

C. F. Robinow, British pioneer in the study of bacterial cytology, and at present in charge of a research project of the Welcome Foundation at Strangeways Laboratories, Cambridge University, will be visiting professor at Indiana University for the second semester of 1947–48.

Aage Jepson, professor of bacteriology, Royal Veterinary College, Copenhagen, Denmark, is on special leave in this country for the purpose of becoming acquainted with faculties and curricula of veterinary colleges, officers of the American Veterinary Medical Association, and regulatory officers in charge of food production and storage and dairy hygiene. Dr. Jepson has already visited several dairy, creamery, food production, and freezer plants as well as packing houses in this country.

M. Désirant, of Liége University, Belgium, who has been working recently at the R. S. Mond Laboratory, Cambridge, England, will arrive in September for a visit to various cryogenic laboratories and for a prolonged stay at Massachusetts Institute of Technology and the National Bureau of Standards.

Grants and Awards

Grants amounting to $181,044, recently authorized by the Sugar Research Foundation, Inc., bring the total allotted by the Foundation for grants-in-aid and special studies to $534,160. The appropriations provide for the continuation of 26 established projects and the initiation of four new investigations: (1) nutritional value of sugar cane juice and studies of the physiology of sucrose and levulose, by Tomas Duran-Quevedo, University of Havana; (2) a study of clay adsorption methods for removing sugar from molasses and commercial applicability of this technique, by L. K. Herndon, Ohio State University; (3) research on special fuels and heating units using sugar, by Frederic S. Bacon Laboratories, Watertown, Massachusetts; and (4) a study of production of lactic acid from molasses and its recovery in a pure state, by the Bjorksten Research Laboratories, Chicago.

George F. Cahill and **Meyer M. Melicow**, both of the Squier Urological Clinic, Presbyterian Hospital, Columbia University, were awarded a gold medal at the Centenary Convention of the American Medical Association, held recently in Atlantic City, for their exhibit on "Tumors of the Adrenal Gland." They also received first prize for the same exhibit at the American Urological Convention in Buffalo.

A grant of $1,500 has been made by the U. S. Vitamin Corporation, New York City, to the Department of Dermatology, New York University College of Medicine, for research in diseases of the skin associated with vitamin deficiencies.

Industrial Laboratories

A. C. Krueger, formerly development engineer, Guided Missiles Project, Republic Aviation Corporation, and during the war with the Manhattan Project, University of Chicago, has been appointed supervising engineer, Antenna Design Section, Airborne Instruments Laboratory, Inc., Mineola, New York. His assumption of administrative direction of the Section, permits **R. S. Wehner**, co-supervisor, to take an active part in the research and development activities of the group. The Section is developing faired-in, dragless antennas for trans-sonic and super-sonic aircraft.

W. Harry Feinstone, director, Biological Research, Pyridium Corporation, has been appointed director of research and development, Central Pharmacal Company, Seymour, Indiana.

Frederic H. Lahee, chief geologist for Sun Oil Company since 1920, has been appointed geological and research counselor of the Production Department. As such, he will be available for consultation on all matters of production science throughout the Company.

Centro Research Laboratories, Inc., is offering a Standard Test Service, which will be of special interest to activities and industries associated with paint, varnish, lacquer, resin, pigment, drug, chemical, oil, soap, lubricant, insecticide, fungicide, electrical insulation, textile treating, paper and pulp finishing. Costs are adjusted to the type of test and the number of samples to be processed simultaneously. Further details may be obtained from the Technical Service Director, Centro Research Laboratories, Inc., Briarcliff Manor, New York.

Eli Lilly and Company Research Laboratories made several organizational changes on July 1. New department heads include **James W. Ferguson**, Organic Chemical Development Process; **Carter C. Boyd**, Chemical Manufacturing Process; **Robert D. Reck**, Chemical Manufacturing Equipment; **Gail L. Shaw**, Organic Chemical Development Equipment; and **Harold K. Leamon**, Organic Chemical Manufacturing.

Hendrik M. Rozendaal, physician, Schenectady, New York, has been appointed to the staff, General Electric Research Laboratory, Schenectady, to serve as liaison representative between the Laboratory and the various groups working in biological research in the field of atomic energy.

Josselyn Farmer, who recently obtained her Ph.D. in organic chemistry from the University of Cincinnati, has been appointed assistant librarian of The Wm. S. Merrell Company, Cincinnati, Ohio.

Ernest B. Benger, research chemist and manager, Rayon Technical Division, Du Pont Company, retired on June 25 after 30 years of service.

Colleges and Universities

Northwestern University's University College and Department of Chemistry, College of Liberal Arts, are sponsoring a series of lectures on "The Chemistry and Physics of High Polymers," to be given every Tuesday evening from September 30 to December 9 in Lincoln Hall, East Chicago Avenue, Chicago. The lectures will constitute a noncredit course and are open only to those who have paid the usual course fee. Lecturers in order of date will be H. Mark, Brooklyn Polytechnic Institute; E. F. Izard, DuPont Company, Buffalo; H. A. Bruson, Resinous Products and Chemical Company, Philadelphia; E. G. Rochow, General Electric Company, Schenectady; R. B. Woodward, Harvard University; W. O. Baker, Bell Telephone Laboratories; P. Debye, Cornell University; Malcolm Dole, Northwestern University; P. J. Flory, Goodyear Research Laboratory, Akron; A. V. Tobolsky, Princeton University; and F. R. Mayo, U. S. Rubber Company, Passaic.

Michigan State College has announced the following appointments in the Department of Chemistry: **Robert M. Herbst**, E. Bilhuber-Knoll Corporation, associate professor of organic chemistry; **Frederic S. Dutton**, Baldwin-Wallace College, associate professor in charge of general chemistry; and **Robert D. Schuetz**, Ohio State University, and **Kenneth G. Stone**, Sun Chemical Company, instructors.

The University of Cincinnati has planned an Institute of Industrial Health which will offer a two-year, highly specialized program of graduate study and training in the field of industrial medicine, leading to the new degree of Doctor of Industrial Medicine. Robert A. Kehoe, director, Kettering Laboratory of Applied Physiology at the University, will direct the new Institute. Requirements for admission will be unusually high, and those accepted will be limited in number.

Meetings

The Society of General Physiologists will hold its annual meeting September 8–9 at Woods Hole, Massachusetts. Programs dealing with transport of ions across cell membranes, cellular metabolism, and other topics in general physiology have been arranged. Accommodations are available at the Marine Biological Laboratory for those who attend the meeting. Reservations should be made directly with the Laboratory.

The Administrative Section on Medical and Allied Professional Sciences of the Association of Military Surgeons will meet at the Hotel Statler, Boston, on November 13–15, inclusive. All officers of the Medical Administrative Corps, Pharmacy Corps, and Sanitary Corps who plan to attend the meetings at Boston are asked to communicate with Major A. E. A. Hudson, SnC, president of the Section, Apt. 1-4, Edgewood Apartments, Goldsboro, North Carolina.

A High-Vacuum Symposium, sponsored by the National Research Corporation in cooperation with the Division of Industrial and Engineering Chemistry, American Chemical Society, will be held at the Hotel Commander, Cambridge, Massachusetts, October 30-31. Attendance will be restricted to technical and scientific personnel concerned with industrial applications of high vacuum.

A Conference on Motor Skills Research, held at the Special Devices Center, Office of Naval Research, Sands Point, New York, June 26–27, was attended by 40 scientists representing some 20 organizations both within and outside the services. Leonard C. Mead, head, Human Engineering Section, Special Devices Center, was chairman of the General Session; Glen Finch, Aero-Medical Laboratory, Wright Field, of the session covering reports on Current and Planned Research on Motor Skills; and J. W. Macmillan, Medical Sciences Division, ONR, of the session on Psychomotor Research in Relation to Military Problems. An open discussion on topics relating to psychomotor research was also led by Leonard Mead.

The State Geologists of Illinois, Iowa, Kansas, Nebraska, and South Dakota, accompanied by staff members and scientific guests, held a field conference on the loess deposits of the upper Mississippi valley region and related problems, June 21–28, inclusive.

The Midwest Field Conference began at the classic Farm Creek section near Peoria, Illinois, continuing along the belt of thick Illinois valley loess east of Havana and Beardstown, Illinois, through western Illinois to southeastern Iowa on the Illinoian drift plain, thence to the loess deposits bordering the Iowan drift plain near Iowa City, westerly along the southern border of the Iowan drift to the Des Moines lobe (Mankato substage), thence to the Iowan drift area of northwestern Iowa and the adjacent Kansan drift, on to the Dakota lobe in southeastern South Dakota, and finally southward through eastern Nebraska to Lincoln, along a traverse that showed a large part of the interesting Pleistocene section of that state.

Those attending *from Illinois* were M. M. Leighton, chief, and H. B. Willman, head, Division of Areal Geology and Paleontology, Illinois Geological Survey, Urbana; *from Iowa,* A. C. Trowbridge, head, Department of Geology, University of Iowa, H. Garland Hershey, state geologist, and Stanley Harris, geologist, Iowa Geological Survey, all of Iowa City; *from Kansas,* R. C. Moore, state geologist and professor of geology, John C. Frye, executive director, State Geological Survey, and professor of geology, and A. Byron Leonard, professor of zoology, all of the University of Kansas, Lawrence; *from Nebraska,* G. E. Condra, dean and chief, Conservation and Survey Division, and state geologist, Eugene C. Reed, associate state geologist, Eck F. Schramm, professor and head, Department of Geology, Alvin Lugn, professor of geology, Mylan Stout, professor of geology, C. Bertrand Schultz, director, State Museum, and Weldon D. Frankforter, assistant curator of Paleontology, State Museum, all of the University of Nebraska, Lincoln, and Gilbert Lueninghoener, professor of geology, Fremont College, Fremont; *from South Dakota,* E. P. Rothrock, state geologist and head, Department of Geology, and Bruno Petsch and Bruce Baldwin, of the University of South Dakota, Vermillion; *from Federal departments and other institutions,* Arthur D. Howard, U. S. Geological Survey, Washington, D. C., Richard F. Flint and Dwight Crandall, U. S. Geological Survey and Yale University, Guy D. Smith, U. S. Department of Agriculture, Ames, Iowa, and William T. Watkins, U. S. Department of Agriculture, Lincoln, Nebraska.

NRC News

With the ending of the war, the unique and highly successful relationship which existed between the Federal Medical Departments and the Medical Advisory Committees of the NRC was to cease, the mission of the committees having been fulfilled. It was clearly evident, however, that the maintenance of professional relationships between the Federal departments and the NRC was still needed in connection with many problems arising in the Armed Forces, the Veterans Administration, and other government agencies. As the date drew near for the dissolution of the wartime committees, impetus for the continuation of the advisory mechanism in the postwar period came from the Surgeon General of the Army. In March 1946, Major Gen. Norman T. Kirk proposed to the president of the National Academy of Sciences that steps be taken to provide continuing cooperation. As a result, a tripartite contract was executed between the Medical Departments of the Army, Navy, and Veterans Administration for financial support of the work. Thus, the collaboration that existed during the war years has been extended.

Since dissolution of the wartime committees in June 1946, new committees have been formed as follows: Committee on Atomic Casualties; Committee on Aviation Medicine; Committee on Chemotherapy; Committee on Hearing; Committee on Medicine, including Subcommittees on Cardiovascular Diseases, Infectious Diseases, Liver Diseases, Tropical Medicine, Tuberculosis, and Venereal Diseases; Committee on Neuropsychiatry; Committee on Pathology; Committee on Sanitary Engineering, including a Subcommittee on Military Water Treatment; Committee on Surgery, including Subcommittees on Anesthesia, Neurosurgery, Ophthalmology, Orthopedic Surgery, Thoracic Surgery, and Vascular Surgery.

Members of the newly-constituted committees were chosen on the basis of their medical and scientific leadership and, since many of the members served in the Medical Departments of the Army and Navy, they have an intimate understanding and appreciation of the problems on which the representatives of the Federal departments desire advice. The questions are carefully and broadly analyzed in open discussion, and if recommendations can be made promptly, these are formulated and forwarded to the department concerned. If there is need for further study and consultation, such problems are assigned to panels within the committee, the chairman of which reports back at the next meeting.

Since the formation of the committees, advice has been sought by the Federal services on a wide variety of problems. One of these—revision of Army and Navy physical standards—will be a major continuing interest of the Committees on Medicine, Surgery, and Neuropsychiatry. Each phase of the physical standards will be critically reviewed by competent specialists who will evaluate physical and mental requirements in relation to job placement. It is believed that this approach to the selection of personnel will enable the services to utilize individuals heretofore considered physically disqualified in assignments wherein effective service may be rendered and may help to prevent great losses of man power such as occurred during the last war. Although many phases of the standards can be revised on the basis of existing knowledge, some may require extensive research on the part of the committees.

The nature and scope of the problems placed before the Medical Advisory Committees by the Federal services are revealed by the following list: (1) evaluation of auditory requirements for admission to the U. S. Military Academy and of research projects in the broad field of audition; (2) evaluation of research on rheumatic fever; (3) evaluation of a study of intracutaneous influenza vaccination; (4) evaluation of penicillin prophylaxis of venereal diseases; (5) establishment of policies regarding the insurability of syphilitic patients; (6) establishment of policies regarding the use of contact lenses and the supply of anesthetic ophthalmic ointments; (7) evaluation of BCG as a prophylactic measure against tuberculosis; (8) evaluation of research projects on epilepsy and other neuropsychiatric disorders; (9) evaluation of vision tests; (10) evaluation of various projects in the field of sanitary engineering.

In addition to the meetings of the Medical Advisory Committees, conferences have been sponsored under their auspices on peripheral nerve injuries, penicillin prophylaxis of venereal diseases, streptomycin therapy of tuberculosis, and recent advances in aviation medicine.

An active interest has also been taken in the promotion of research within the Federal Medical Departments. In cooperation with the Committee on Veterans' Medical Problems, proposals have been made for clinical studies of conditions which arose during the war, including extensive studies in medicine, surgery, and neuropsychiatry. Among the studies currently under consideration are: a follow-up study of peripheral nerve injuries, investigation of the late results following repair of arterial aneurysms and arteriovenous fistulae, liver function in veterans following hepatitis and other conditions. The committees also serve in an advisory capacity in connection with research proposals originating in the Army, Navy, and Veterans Administration. They thus exercise an important influence upon federally-sponsored research in medicine and allied fields.

The Chemotherapy Center for Tropical Diseases is continuing its work, though on a reduced scale, since demands for drugs required for the cure and prevention of various tropical infections are no longer urgent. Under the direction of the Center, pharmacologic and toxicologic tests have been carried out on a variety of drugs that may be effective in the treatment of amebiasis, leshmaniasis, schistosomiasis, and other infections.

As the newly-constituted Medical Advisory Committees near the end of their first year of activity, it may be said that their work may prove equally far-reaching, if less dramatic, than that of their wartime counterparts. Certainly, the knowledge and experience of the civilian physicians on the committees, as it is brought to bear on the medical problems of the Army, Navy, and Veterans Administration, will go a long way toward the maintenance of high professional standards in the Federal medical services. The work of the committees will also have an important bearing upon the Nation's medical preparedness.

An international journal, *Spectrochimica Acta*, the publication of which was begun in 1939 by Julius Springer, Berlin, and interrupted shortly afterward by the war, has been re-established as an international organ for spectroscopists and spectrochemists, and is being published in the Vatican under the editorship of Alois Gatterer, assisted by a group of co-workers from other countries, as follows: R. Breckpot (Belgium), H. Kaiser (Germany), E. Van Someren (England), and Lester W. Strock (United States). The first number (No. 1, Vol. 3) is now ready for press, and it is expected that 6–8 numbers a year will be issued. The official languages of the journal are English, French, and German; papers will also be accepted in both Italian and Spanish. Papers in English from this country should be submitted to Lester W. Strock, 21 Madison Avenue, Saratoga Springs, New York.

The U. S. Civil Service Commission has announced probational employment opportunities as Technical Editor, at salaries ranging from $3,397 to $5,905 per year; as Director, Technical Information, at $7,102 per year; and as Writer (Military Manual), at $4,140 per year. Vacancies are located at the Army Chemical Center, Maryland. Competitors for these positions will not be required to take a written test. Further information concerning these openings may be obtained at most post offices, and forms may be obtained from the Executive Secretary, Board of U. S. Civil Service Examiners, Army Chemical Center, Maryland, or from the Director, Fourth U. S. Civil Service Region, Nissen Building, Winston-Salem 3, North Carolina. Applications will not be accepted after September 8.

A long-range program of research on waterproofed papers is under way at the National Bureau of Standards under a fellowship of the Waterproof Paper Manufacturers Association. Robert C. Reichel, whose services are being provided by the Association, is acting as research associate. Laboratory facilities and technical assistance are furnished by the Bureau. Current work involves the development of a suitable accelerated aging test for predicting permanence of a wide variety of papers. Tests for measuring changes in their properties when exposed to deteriorating influences will be undertaken. Other projects will include means of reducing their flammability, relation of properties of waterproofing asphalts to performance of the papers, and odor and taste problems in food packaging.

The Rockefeller Institute for Medical Research plans to consolidate all phases of its program on its York Avenue site in New York City. The integration in New York of the Department of Animal and Plant Pathology with the Departments of the Laboratories and the Hospital has recently been approved. Most of the activities at the Institute at Princeton will be transferred to the New York plant with the belief that they will be greatly strengthened by making possible a day-to-day exchange of ideas between the members of the entire scientific staff. It is hoped that this integration may be accomplished by July 1, 1951.

Make Plans for—

American Astronomical Society, 77th meeting, September 3–6, Dearborn Observatory, Evanston, Illinois.

First International Biometric Conference, September 5–6, Marine Biological Laboratory, Woods Hole, Massachusetts.

Laurentian Hormone Conference of the AAAS, September 8–13, Ste. Adele Lodge, Ste. Adele, Quebec.

American Psychological Association, September 9–13, Detroit, Michigan.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Calcium and Growth in Aging and Cancer[1]

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This paper is an attempt to bring together data on changes in intracellular calcium as an important factor in both aging and malignancy. A calcium increase with age has been demonstrated in a wide variety of organisms by many investigators, some of whom are Novi (*20*), Cahane (*5*), Burger and Schlomka (*4*), Simms and Stolman (*22*), Lansing (*12*, *13*), and Blumenthal, Lansing, and Wheeler (*2*).

Between the cells calcium is increased in some locations and even decreased in others. It is with the cells themselves that we are concerned, both in aging and in cancer production. Lansing (*12*, *13*) noted a marked increase with age in the calcium content of the cell periphery or cortex. This was demonstrated in a plant, a rotifer, a planarian, and a toad. At that time it was suggested that an increase with age in the calcium content of the cell cortex might produce a decrease in permeability of the cell membrane. It was further suggested that a permeability decrease might result in an accumulation of metabolic waste products in the cell which could, in turn, produce the changes associated with senescence.

This view is not without support. Benedict (*1*), as a result of his permeability studies in plants, suggested that aging is a result of decreased cellular permeability. Molisch (*17*) believed that there might be a relation between a calcium increase and a permeability decrease with age in plants. That senescence may be a consequence of progressive accumulation in the cell of materials which either are toxic or obstruct metabolism has been frequently suggested (Jickeli, *10*; Montgomery, *18*; Child, *6*; Seifriz, *21*; and Heilbrunn, *9*).

A series of experiments were conducted by the writer to determine the effect of experimental alteration of the calcium content of cells on longevity (*14*). It was found that, under carefully standardized environmental, nutritive, and genetic conditions, rotifers in a low calcium medium live longer than control animals. It was further shown that experimental removal of calcium from cells of the rotifer by sodium citrate results in a marked increase in longevity. The ability of sodium citrate to remove calcium from the cell cortex was demonstrated by microincineration and electron microscopy (*16*).

The mechanism of aging as set forth is obviously incomplete in that a serious gap exists in the postulated chain of events. Why does calcium increase with age in the cell cortex? This discussion of experiments on longevity and chemical studies on cancer may make it possible to relate the calcium change with age to a mechanism governing growth cessation of cells.

The results of a wide variety of experiments on the effect of starvation on longevity are in essential agreement that starvation increases longevity by extension of the period of growth. Northrop (*19*), in his experiments on *Drosophila*, showed that semistarvation resulted in increased total duration of life. Increased longevity was due to a prolongation of the period of growth; length of the adult period of life was unaffected. Similarly, Kopec (*11*), working with *Lymantria*, *Drosophila*, and tadpoles concluded that prolongation of total duration of life is effected by an extension of the period of growth and that the adult period is not increased. Comparable results with rats have been obtained by McCay and his associates in an extensive series of investigations (*8*). It would appear from these and similar experiments that the length of the period of growth may condition longevity and that cessation of growth may set off the aging mechanism.

Recent experiments by Lansing (*15*) and current unpublished data indicate that cessation of growth is, in fact, a critical turning point in initiation of age changes. Use was made of standardized nutritive and environmental conditions and genetically homozygous rotifers with parental age as the sole variable. Longevity of successive generations of rotifers was traced, parental age being uniformly maintained and lines of young and old parentage contrasted. Lines of old parentage showed progressive decline in mean life span, and all became extinct after a limited number of generations. However, lines of young parentage maintained and increased mean life spans.

Significant in the present discussion is the observation that there is a sharply defined transition between ages of lines that maintain and increase longevity or progressively reduce it. Lines of a parental age younger than that at which growth ceases show progressively increased longevity and are evidently free of any age change *All* lines of parental age older than that at which growth ceases show progressive reduction of mean life spans to the point of nonviability. The conclusion is warranted that the process of aging is a consequence of changes which occur with cessation of growth.

If cessation of growth is a significant factor in aging and if a mechanism involving calcium increase is an integral part of this system, one would expect to find the very opposite situation in cancer. Cancer may be regarded as a very youthful and vigorous tissue with tremendous and uncontrolled growth capacity.

It has been shown repeatedly that cancer tissue is markedly low in calcium. Recently, Suntzeff and Carruthers (*23*) have shown that there is a 50 per cent reduction of total calcium in methylcholanthrene-induced epidermal hyperplasia from that of normal epidermis, and in squamous cell carcinoma a still further reduction of approximately 60 per cent from the precancerous hyperplastic epidermis. Brunschwig, Dunham, and Nichols (*3*) also discovered a sharp drop of calcium in cancer tissue.

In an extension of the observations of Suntzeff and Carruthers, Lansing, Rosenthal, and Au (to be published) studied the nature of the calcium drops in hyperplastic mouse epidermis and resulting carcinomas by means of ultrafiltration,

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[1] Supported in part by grants from the Josiah Macy, Jr. Foundation.

It was found that the ultrafilterable calcium fraction of a squamous cell carcinoma was sharply reduced on both an absolute and relative basis. The conclusion was reached that the base-binding capacity of an organic fraction which binds calcium is altered in cancer. It is reasonable to expect that this calcium binding complex, which changes in cancer to limit calcium uptake, is located like that demonstrated by Heilbrunn in the cell cortex. The work of Heilbrunn and his associates, covering a number of years, are summarized in his book (*9*).

Further supportive but indirect evidence for the localization of the calcium change in cancer in the cell surface can be found in the work of Coman (*7*), who has found that normal cells are more readily separated by micromanipulation when in calcium-free medium than when in balanced salt solution. Further, he has demonstrated that cancer cells are more readily separated than are normal cells, and the suggestion was made that the decreased adhesiveness of cancer cells results from a local calcium deficiency which facilitates separation of these cells from one another.

Thus, the evidence presented, while undoubtedly weak, makes it possible to correlate the various changes described in a single hypothesis. It seems quite likely that an organic calcium-binding complex of the cell cortex plays an integral part in the growth regulatory mechanism of cells and that at the time of cessation of growth this calcium-binding complex, presumably a protein, is altered or reoriented in such a way as to increase calcium-binding capacity. Thus, a mechanism is offered which at least in a general way synchronizes the changes that occur with age. On the other hand, when the calcium binding system alters in such a manner as to decrease calcium binding, growth does not cease, age changes do not occur, and, in effect, the state of affairs exists that is associated with cancer. This hypothesis is also compatible with Coman's concept of the invasiveness of cancer.

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Coproantibody Excretion During Enteric Infections[1]

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The immune mechanism responsible for initiation of recovery from infections confined essentially to the lumen and mucosa of the intestinal tract, viz., cholera, bacillary dysentery, and certain *Salmonella* infections, is suggested by the recent work of Burrows and co-workers (*1*), who showed that antibody is excreted in the feces by both infected and immunized animals and immunized human volunteers, and that immunity to experimental infection is associated with its presence. They showed that the appearance of coproantibody precedes that of serum antibody, reaches peak titer and declines while serum antibody is still rising, and completely disappears despite the persistence of serum antibody. They suggested that the independent behavior of serum and fecal antibody might be explained on the assumption that the latter represents intracellular antibody, possibly transported to the lumen of the bowel by lymphocytes. However this may be, the late appearance and persistence of serum antibody strictly limits its diagnostic utility, but the behavior of coproantibody suggests that it might be useful both in the rapid diagnosis of specific acute enteric infection and in providing a clue to the possible etiology of chronic diarrheal disease such as chronic ulcerative colitis.

TABLE 1

Coproantibody Excretion From Patients Suffering From a Variety of Enteric Infections

Clinical diagnosis	No. cases	Pathogens isolated	Copro-antibody present
Acute bacillary dysentery	20	*S. sonnei* from 6; *S. flexneri* from 5; none from 9	20*
Chronic bacillary dysentery	18	*S. sonnei* from 3; *S. flexneri* from 5; none from 10	18†
Acute diarrhea	14	Various *Salmonella* from 10; none from 4	14†
Chronic diarrhea	35	Para A from 9; Para B from 3; none from 23	32‡
Chronic ulcerative colitis	5	*S. flexneri* from 1; *S. sonnei* from 2; none from 2	5§

* Eleven, 1:640 or above; 8, 1:320; 1, 1:160 (maximum titers obtained).

† Coproantibody titer of 1:160 or above obtained against homologous organism, or against one or more species of enteric pathogens, on several occasions from each patient.

‡ Three failed to show coproantibody at any time during the observation period.

§ Usually obtained in highest titer during episode of exacerbation of disease.

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[1] Aided in part by a grant from the M. D. Anderson Foundation of Houston.

[2] The authors are indebted to William Burrows for making available copies of translations from the Russian (*4*) furnished him by the Translation Unit of the U. S. Public Health Service.

Although we were unaware of previous reports of the presence of fecal antibody in dysenteric stools at the time this work was initiated, it was of some interest to find that Davies (*2*) earlier had demonstrated antibody in dysenteric stools and suggested use of serological examination of feces for rapid diagnosis of acute bacillary dysentery. More recently, Soviet investigators (*4*) have utilized fecal antibody titration in early diagnosis of bacillary dysentery.

The present report is concerned with some observations on the presence of antibody in fecal specimens from patients with a variety of enteric infections. The method of preparation of fecal specimens was essentially that used by Burrows (*1*). Agglutinin titration was carried out in the usual manner. Examinations were made at frequent intervals during active infection and convalescence and, in some instances, over a period of several months. Serum and fecal agglutinin titrations were carried out simultaneously with stool cultures.

Table 1 summarizes the results. The grouping of patients was based on the clinical diagnosis, isolation of enteric pathogen, and presence of fecal agglutinins for the particular infectious agents indicated. Although positive cultures were obtained from only 47.8 per cent of the patients included in the table, it is of some interest that fecal agglutinins were found in 96.7 per cent of the cases. Thus, of 20 cases of acute bacillary dysentery and 18 of chronic bacillary dysentery, all showed fecal agglutinins of significantly high titer; likewise, of 14 cases of acute diarrhea and 35 of chronic diarrhea, most of the fecal specimens contained high-titer agglutinins. Three in the latter series failed to show coproantibody at any time during the observation period. Five cases of chronic ulcerative colitis were studied; fecal agglutinins were demonstrable in high titer in all cases during one or more episodes of exacerbation of the disease.

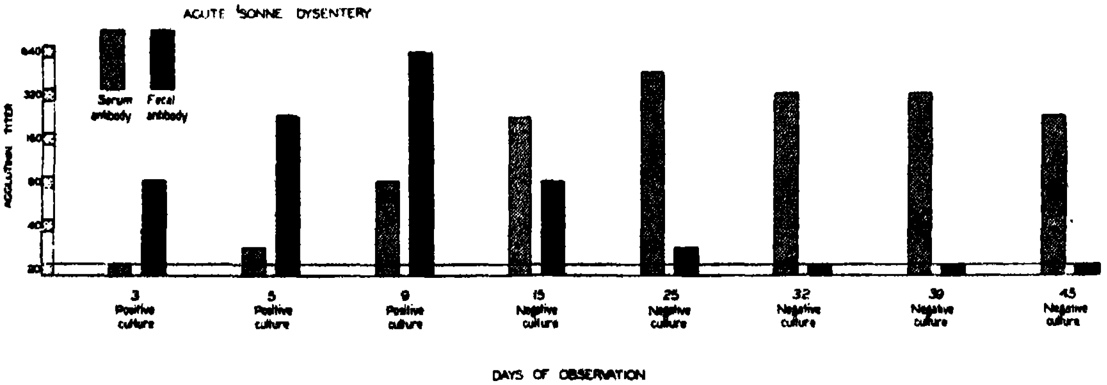

FIG. 1. Summary of serum and fecal agglutinin response in acute bacillary dysentery.

Fig. 1 illustrates the typical serum and fecal agglutinin response observed in acute bacillary dysentery. Fecal agglutinins were demonstrable as early as the 3rd day of disease, rose to high titer by the 9th day, and disappeared soon after stool cultures became negative and after recovery definitely was established. On the other hand, circulating antibody did not appear to significant titer until about the time recovery was initiated, but then rose to high titer and remained at a high level during the period of observation.

In cases of chronic bacillary dysentery significant fecal agglutinin titers were obtained on several occasions from each patient during the period of examination. Acute diarrhea of *Salmonella* origin followed the fecal antibody pattern of acute bacillary dysentery. In chronic *Salmonella* infections it was possible to obtain high-titer fecal agglutinins on one or more occasions during the period of observation. In chronic ulcerative colitis it was found that relatively high-titer fecal agglutinins for at least one species of *Shigella* were present during episodes of exacerbation of symptoms.

It is of some interest that, in those instances in which positive cultures were obtained, fecal agglutinins were found in highest titer during the period in which presumably the greatest numbers of the causative organism were excreted, *i.e.* during greatest activity of the infection, but disappeared after recovery was established. Although it is not clear as to the origin of fecal antibodies in these infections, it is significant from a diagnostic point of view, and presumably for initiation of recovery, that antibody is excreted during the active phase of the infection or, in the case of chronic infections, during periods of clinical activity of the disease. The diagnostic utility of these observations is obvious, for in instances in which no etiologic agent can be found, the presence of fecal agglutinins appears to indicate, indirectly at least, the probable causative organism. The finding of fecal agglutinins for various species of *Shigella* from patients suffering from chronic ulcerative colitis is interesting with respect to Felsen's (*3*) views on the relation of bacillary dysentery to chronic ulcerative colitis. More important from the point of view of the patient is the role coproantibody plays in initiating recovery; that it is not completely effective in some instances is indicated by finding fecal agglutinins to high titer in chronic forms of enteric infection. Under such conditions however, the demonstration of coproantibody parallels evidence of clinical activity of the disease, even though the infectious agent is not recovered.

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Atherosclerosis and Alimentary Hyperlipemia[1]

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The purpose of this communication is to report investigations which demonstrate that the physical state of the plasma lipids is the same during alimentary hyperlipemia as in those sustained hyperlipemic conditions that are known to predispose to the relatively rapid and severe development of atherosclerosis. The many extensive studies on plasma cholesterol concentrations have failed to provide the answer to the usual development of some degree or another of this slow process of intimal lipid deposition in most otherwise normal persons (*6*, *7*, *9*). It is here proposed that it is because only lipid *concentrations* have been investigated, and primarily in the postabsorptive (fasting) state, that the clue to the underlying etiology of atherosclerosis has been missed.

The investigation of the physical state of the plasma lipids in normal humans and animals, and under various pathological, physiological, and experimental conditions, and the correlation of these data with the pathogenic development of atherosclerosis, have been the focal points in our studies (*6*). Our approach to the study of the actual physical state and particle size of the plasma lipids has involved three simple methods:

(1) *Direct observation and photomicrography of high-power, dark-field preparations:* This method does not lend itself to accurate quantitative estimations, but does providedirect visual observation of only the larger colloidal lipid particles, which appear as bright points of light of varying sizes. These particles are in Brownian motion to a greater or lesser degree, according to their size. This technique has in the past been of occasional interest to physiologists in the study of fat absorption. Gage and Fish (*5*) in 1924 demonstrated that the plasma of normal humans and animals in the fasting state contains very few lipid particles which are of sufficient size to be visible in the dark field. After a fatty meal, however, large and visible particles ("chylomicrons") appear in great numbers. During this alimentary hyperlipemia the chemical concentration of the fat in the plasma may be increased by one-fourth to three-fourths, but the number of chylomicrons seen in the dark field may be increased 10- to 20-fold. This has two rather obvious implications: (a) In fasting plasma specimens the lipids are for the most part carried in very small and invisible colloidal particles; (b) the striking disproportion between the marked increase in visible lipid particles as compared with the relatively slight increase in chemical concentrations is evidence that the average particle size of these absorbed lipids is much greater than is found in the fasting state or after a nonfatty meal.

Our observations were first directed, however, toward the study of the dark-field picture in sustained hyperlipemia, *i.e.* in humans with hyperlipemic diabetes mellitus, myxedema, nephrosis, and xanthomatosis, in cholesterol-fed rabbits and chickens, and in stilbestrol-injected chickens. In these hyperlipemic states the dark field reveals, in a single oil-immersion field, hundreds to thousands of lipid particles which are of sufficient size to be directly visible by light reflection. These are of varying sizes, and many are so large as to exhibit little or no Brownian motion. This is a markedly different picture than that found in the plasma of normal fasting subjects or after a fat-free meal where only a very few (20–30) tiny, dancing lipid particles can be found in each field; furthermore, these few visible particles in fasting plasma appear for the most part as dull specks and are at the extreme lower limit of detection in the dark field. From our later studies on alimentary hyperlipemia it became obvious that the *hyper-* and *macrochylomicronemia* that follow the ingestion of a lipid-rich meal reproduces the same condition of increased particle size and coarser particulate distribution of the lipids in the plasma as found in sustained hyperlipemia of pathological or experimental origin. (These new terms are used as descriptive of the condition of markedly increased numbers of large lipid particles in the plasma.) Although a fatty meal causes only a slight and insignificant elevation in plasma cholesterol concentrations, it nevertheless does reproduce for 3–5 hours this same pronounced alteration in the physical state of the plasma lipids (increased particle size) that is found to be characteristic of those sustained hyperlipemic states that result in the early and severe development of lipid deposition in the arterial intima.

Microscopic counts and estimations of particle size in fasting plasma and in hyperlipemic plasma are quite impractical. Therefore, other methods were needed for the quantitative comparison of the physical state of the plasma lipids in these various conditions.

(2) *Tyndall effect and nephelometry:* Lipid particles in dark-field preparations are demonstrated only by a light-scattering effect. This light-scattering by a medium containing colloidal particles increases with the particle size as well as the number of particles present. A reliable means of comparing the physical status of the lipids in various plasma samples resides in the quantitative study of their Tyndall effect. Plasma (or serum) specimens that scatter the most light are those containing the greater number of larger lipid particles. The relatively small amount of light-scattering due to the plasma proteins may be considered part of the normal baseline. It is evident, then, that measuring the intensity of the light scattered at right angles by a standard amount of plasma and a standard light beam will give a fair quantitative estimation, for comparative purposes, of the physical state of the plasma lipids. Therefore, an especially designed photoelectric nephelometer was constructed for this purpose. Typical comparative values found by this method are given in Table 1.

(3) *High-speed centrifugation:* Stoke's law states that the rate of settling of particles from a liquid medium is dependent on the size of the particles and that larger particles settle (to the top or bottom, depending on specific gravity) more rapidly than smaller ones. When plasma is centrifuged, the larger particles of the plasma lipids will rise to the top more readily than

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[1] This is an introductory article to a series of reports on atherosclerosis which are to follow from this laboratory. Gratitude is expressed for the invaluable encouragement and criticism of this work by the late Joseph Edgar Tyree; the author also wishes to acknowledge the aid of L. G. Moench, of the University of Utah Medical School and the Salt Lake Clinic, and also F. L. Stauffer. The photoelectric nephelometer was constructed with the technical assistance of F. S. Stauffer, C. L. Peterson, and R. H. Starley. This instrument, along with the design and theory of nephelometry as applied to the study of the physical state of the plasma lipids, will be reported in detail in a subsequent communication.

[2] The early part of this work was done while the author was at the Harvard Medical School and on the resident staff of the Massachusetts General Hospital.

the smaller ones. When samples of serum or plasma are spun at moderately high speeds (*i.e.* 16,000–18,000 r.p.m.) in the same rotor for a given length of time, those containing greater numbers of larger particles will give a wider 'cream line' or thicker layer of lipid particles which have risen to the top than is found in those plasma samples with a smaller average lipid particle size. Estimation of the volume per cent occupied by the lipid particles which have come to the top provides, therefore, another method for the study and comparison of the physical state of the plasma lipids.

TABLE 1

Subject	Tyndall light (microamperes)
In the postabsorptive state:	
Average of 20 normal humans, fasting	34
" " 8 rabbits on normal diet, fasting	28
" " 8 steers " " " "	26
Sustained hyperlipemia:	
Average of 6 rabbits after 10 weeks cholesterol feeding	980
" " 5 stilbestrol-injected chickens	740
Diabetic patient with sustained hyperlipemia	720
" " " " "	540
" in acidosis	820
Nephrotic with sustained hyperlipemia	620
Essential xanthomatosis with sustained hyperlipemia	890
Alimentary hyperlipemia:	
R.L.T., normal adult human, fasting	28
4 hours after 50 grams of butter fat	140
S.M., normal adult human, fasting	40
4 hours after 50 grams of butter fat	156
R.A.P., normal adult human, fasting	31
4 hours after 50 grams of butter fat	159
B.B.P., normal adult human, fasting	24
4 hours after 50 grams of butter fat	93
C.L.P., normal adult human, fasting*	91
4 hours after 50 grams of butter fat	433
R.H., normal adult human, fasting	29
4 hours after 50 grams of butter fat	184
A.B.L., normal adult human, fasting	32
4 hours after 50 grams of butter fat	137
M.A.E., normal adult human, fasting	44
4 hours after 50 grams of butter fat	280

* Repeated tests on this otherwise normal man have shown him to be unusually sensitive to the development of *hyper-* and *macrochylomicronemia* following various fat-rich test meals. We have noted others who have similarly been exceptionally sensitive in this regard to fatty meals.

There is a fairly reliable degree of correlation between comparative estimates of the physical state of the plasma lipids by the above three methods. That the lipid particles in the plasma following a fatty meal contain cholesterol has been readily demonstrated by analysis for cholesterol of the lipid layer that comes to the surface as a result of high-speed centrifugation (*6*). This is true even after a cholesterol-free fatty meal, *i.e.* olive oil; the logical source of this cholesterol is the bile which is called forth in large quantities for the emulsification of a fatty meal. It is not surprising that chylomicrons contain cholesterol as well as triglycerides and fatty acids; for, being lipids which are both insoluble in water and mutually soluble in each other, they may be expected to be found together in the same lipid particles, rather than carried each in separate micelles.

In summary, it has been found that during the 3–5 hours following a fatty meal the physical state of the lipid particles appearing in the plasma is qualitatively the same as in sustained hyperlipemia. This alteration in physical state consists of markedly greater numbers of lipid particles of considerably larger size than those found in normal fasting plasma or after fat-free meals. From these studies the theory is here put forth that the cumulative effect of many fatty meals over a lifetime, by producing these transient showers of large lipid particles in the plasma may be the underlying cause of the intimal lipid deposition in human atherosclerosis. This deposition takes place primarily in the tissue spaces of the arterial intima between the overlying endothelium and the underlying barrier of the fenestrated internal elastic membrane (*1*). The lipid particles must be assumed to be retained and deposited from the plasma-derived nutrient lymph stream which normally passes from the lumen through the intramural structures toward the adventitial venules and lymphatics (*1*). It may be theorized that the increased particle size of the lipids in sustained or alimentary hyperlipemia is the stimulus to the phagocytosis in the intima by macrophages and the formation of the typical 'foam cells.' The barrier function of the fenestrated or even reduplicated internal elastic membrane may have an important role in the mechanics of the process of lipid-particle retention in the intimal tissue spaces (*1*, *6*). The neutral fats and fatty acids in the depositing lipid particles are more readily resorbed and removed (by the action of macrophages and tissue-fluid enzymes) than cholesterol and cholesterol esters, which remain as the difficult-to-remove residue (*6*). Christianson (*3*) has shown this experimentally by demonstrating that if a mixture containing 95 per cent fat and 5 per cent cholesterol is injected intramurally and deposited in the arterial wall with a fine hypodermic needle, the resultant lipid lesion soon consists primarily of cholesterol due to the much more rapid resorption and removal of the fats and fatty acids from the deposit.

Circumstantial evidence on the occurrence of atherosclerosis supports this chylomicron theory of etiology as above outlined: (a) Atherosclerosis is rare in peoples who eat very low or nearly fat-free diets, *i.e.* Chinese and Okinawans (*8*); (b) atherosclerotic disease decreased notably in Germany during the fat-shortage years immediately following World War I (*2*); (c) atherosclerosis is more common in obese, overnourished persons than in the lean and undernourished; (d) it is often less severe and less common in chronic alcoholics (who eat less, especially less fat, for which they often have intolerance) than in nonalcoholics (*6*); (e) intimal lipid deposition and atherosclerosis are rare and minimal in wild animals (including the herbivorous anthropoid apes), which seldom, if ever, eat a meal containing the amount of fat found in the average human diet (*1*, *4*).

This theory, along with a thorough review of the literature and further investigations from this laboratory, will be presented in full in a forthcoming monograph (*6*).

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IN THE LABORATORY

Penicillin Types Produced by *P. Chrysogenum* Q-176

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The organism *P. chrysogenum* Q-176 (*1*) has been widely used for the commercial production of penicillin. It has been recognized that this mold can produce several types of penicillin, although the literature (*4*) is not clear on the number of different penicillins actually produced.

It has now been found that Q-176, grown on the usual corn steep liquor-lactose medium apparently can produce at least 8 penicillins. These include the common types (*2*), namely, G-penicillin (benzylpenicillin), F-penicillin (Δ^2-pentenylpenicillin), what is probably dihydro-F-penicillin (n-amylpenicillin), K-penicillin (n-heptylpenicillin), and X-penicillin (p-hydroxybenzylpenicillin). In addition, three other penicillin types have been demonstrated to be produced in small amounts by this organism.

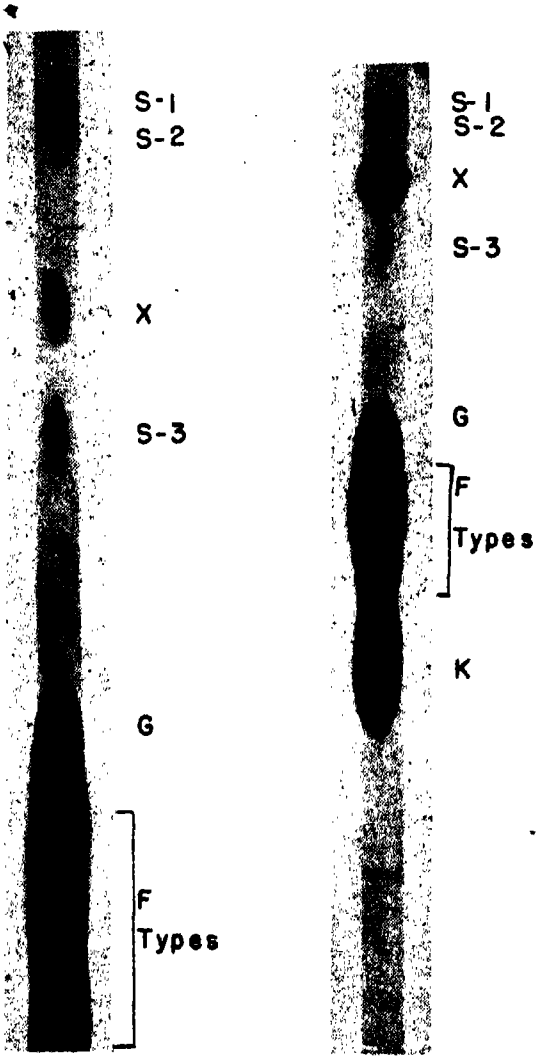
In proving the presence of the indicated penicillins, a paper partition chromatographic method similar to that described by Goodall and Levi (*3*) has been used. These workers obtained evidence for the existence of penicillins other than F (I), G (II), X (III), and K (IV), but did not state the origin of such penicillins.

In determining the types of penicillin present in Q-176 fermentation broth, the method of Goodall and Levi was modified. Thus, the chromatograms were developed at room temperature (about 24°C.), in a 2- to 4-hour period, using Whatman #4 paper strips buffered at pH 5.0 with 25 per cent phosphate buffer, and amyl acetate as the developing solvent. The fermentation broth was adjusted to pH 5.0 before taking an 0.008-ml. drop for analysis.

After developing the chromatograms, the strips were air dried and placed on FDA agar plates which had previously been seeded with *Staph. aureus* 209P. The plates were incubated at 37° C. for 18 hours.

In looking for penicillins which may be present in trace quantities in a fermentation broth, it was found necessary to remove the paper strips from the agar plates after termination of the period of bacterial growth. Upon removing the strips, one frequently notes the presence of zones of inhibition which were too small to extend beyond the covering paper strip; there is sufficient bacterial growth beneath the strip to delineate such zones clearly.

In Figs. 1a, 1b, and 2 are shown the results obtained using the paper chromatographic method of analysis as applied to 5-day-old *P. chrysogenum* Q-176 fermentation broth, the photographs being taken after removal of the paper strips from the agar plates. The organism Q-176 was grown in the usual corn steep liquor-lactose medium (4.5 per cent corn steep liquor by volume, 2 per cent lactose by weight) without addition of specific penicillin precursors



1a 1b

FIGS. 1a and 1b: Chromatographic analysis of undiluted 5-day-old *P. chrysogenum* Q-176 fermentation broth.

In Fig. 1a two small, separate zones of inhibition, designated S-1 and S-2, can be noted. These zones are due to penicillin types not hitherto reported as being produced by Q-176. Proof that they are due to penicillin-type antibiotics will appear below.

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[1] The authors wish to thank E. C. Williams, director of research, for his encouragement and suggestions in this work. Thanks are also extended to Harry Eagle for the gift of pure penicillins X, F, and K.

The third zone from the top has been shown to be due to penicillin X. This was accomplished by adding known penicillin X to a fermentation broth and then chromatographing. Only the third zone was enlarged by the added penicillin X (Fig. 1b). In this case the chromatogram was not developed sufficiently to show the complete separation of penicillins S-1 and S-2.

The fourth zone from the top, designated as S-3, represents a third new penicillin type.

The penicillin types S-1, S-2, X, and S-3 are followed on the chromatogram by a multiple connected zone of inhibition, part of which may be seen in Fig. 1a. It has been found that this multiple zone consists of at least four parts, due to four penicillins: G, F, possibly dihydro-F, and K.

In order to show the component parts of the connected zone, it is advisable to use a diluted fermentation broth; otherwise, there may be a marked overlapping of zones which makes it difficult to see the true nature of their multiplicity

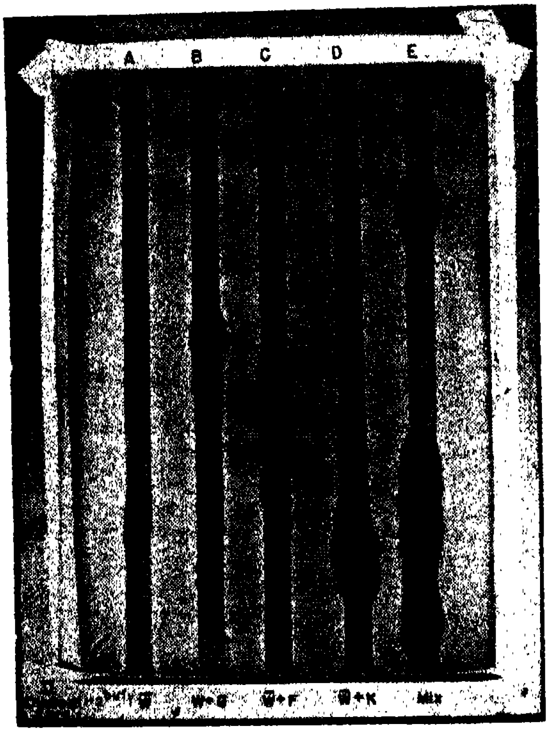

FIG. 2: Chromatographic analysis of 5-day-old *P. chrysogenum* Q-176 fermentation broth diluted to contain 75 units/ml.

Fig. 2 shows the results of an experiment designed to identify the component penicillins responsible for the connected zone of inhibition. In obtaining the results indicated in strip A, a sample of fermentation broth of Q-176 diluted to 75 units/ml. was chromatographed. Four zones, indicated by either separate ellipses or bulbous swelling formed by overlapping ellipses, show the presence of at least four different penicillin types.

These four zones were identified, by adding in turn to the same broth samples of pure, known penicillins, then chromatographing and observing which of the four zones was accentuated by the addition. The modified chromatograms so obtained revealed the identity of the penicillin types observed in the original chromatogram.

In this way, the first zone in chromatogram A of Fig. 2 was identified as being due to penicillin G (see modified strip B); the second zone was identified as being due to penicillin F (see modified strip C); the third zone was tentatively ascribed to dihydro-F, but without confirmation, because no unequivocal sample of dihydro-F was available for comparison; and the fourth zone was identified as being due to penicillin K (see modified strip D). It is to be noted that, due to some artifact, the K zone in strip A is smaller relative to the other zones than is usually the case. Thus, the K zone in strip B is more typical of the size and shape of the K zone relative to the other zones.

Strip E in Fig. 2, representing the results of chromatographic analysis of a mix of known penicillins X, G, F, and K, demonstrates the well-defined separation of the X zone and the overlapping tendency of the G, F, and K zones.

That all the zones observed in the paper chromatographic analysis of Q-176 broth are due to penicillin-type antibiotics is evidenced by the fact that these antibiotics are all destroyed by penicillinase.

It would appear, therefore, that *P. chrysogenum* Q-176 can produce no less than 8 penicillins when grown on the usual corn steep liquor-lactose medium. Four of these, S-1, S-2, X, and S-3, are produced in small quantities; in addition, four other well-known types, G, F, what is probably dihydro-F, and K, are also formed. The new penicillins S-1, S-2, and S-3 have not as yet been characterized chemically.

Addendum: Since submitting this paper, our attention has been called to a report (National Institute of Health release) presented by C. J. Salivar, V. V. Bogert, and E. V. Brown at the Conference on Antibiotic Research held in Washington, D. C., January 31 and February 1, 1947, under the auspices of the Antibiotics Study Section of the National Institute of Health. These workers have reported that Q-176 may produce Δ^2-pentenylpenicillin as well as possibly one or two additional penicillins which may be related to penicillin K. The method of analysis used by Salivar, *et al.* was a column chromatographic method supplemented by the Craig countercurrent distribution method, using ether as the solvent. We have found that the order in which the different penicillins appear in our paper chromatograms does not change whether ether or amyl acetate is used. Since the new penicillins we are reporting, namely, S-1, S-2, and S-3, have solubility characteristics more closely allied to penicillin X, they are probably not identical with those reported by Salivar, *et al.*, which are similar in solubility characteristics to F and K. Using the paper chromatographic method of analysis, only two F types and one K type of penicillin were observed. This may be due to the inability of the paper chromatogram to differentiate Δ^2-pentenylpenicillin and the new K-types suggested by Salivar, *et al.* It would seem, therefore, that according to our work and that of Salivar, *et al.*, Q-176 can produce as many as 11 penicillins.

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Use of Trisodium Phosphate in Microscopical Technic

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The writers (*2*) published a preliminary report on the use of trisodium phosphate as a reagent for reclaiming preserved zoological specimens which have become dry by the complete evaporation of the preserving liquid. Discovery of this method was incidental to a series of studies in which various detergents were used to facilitate penetration of fluids in the preparation of microscopic mounts of parasitic worms. A series of memoranda by Hance (*1*) called attention to the fact that wetting agents added to fixing reagents hasten the penetration of the killing fluids into the tissues. Dr. Hance also pointed out that a wetting agent increases the speed with which many staining reactions are accomplished, while, added to albumin fixative, it makes the spreading of paraffin ribbons much more certain. In addition to these uses in microscopic technic, the present writers have found that the action of trisodium phosphate on preserved parasitic worms seems to increase noticeably the permeability of tissues to all the histological reagents. The effect upon the tissues seems to be much more profound than would be accounted for by the chemical merely reducing the surface tension of the fluids. Entire histologically fixed organisms become much softened when treated with trisodium phosphate, but there is no apparent damage to the tissues such as occurs when potassium hydroxide is used.

For many years in this laboratory serious difficulties have been encountered in securing permanent whole mounts of Acanthocephala. Similar difficulties are often experienced in handling nematodes and other organisms intended for microscopic study. Very commonly, stained specimens, after careful dehydration and clearing, turn chalky white and become entirely opaque after being introduced into balsam or clarite. To avoid this, it became routine procedure to prick the body wall of all specimens with a very fine needle before placing them in stain. By using a dissecting binocular, the perforations may be made in places where relatively little damage to the body wall or underlying structures results. However, in many instances internal organs are injured, and in all cases the punctures mar the appearance of the finished mounts.

It should be recalled that the entire body of all acanthocephalans is completely invested by a thin, noncellular cuticula. This plays an important role in the life processes of the worm and, even following death, continues to determine the passage of fluids through the body wall in both directions. Since there is not the slightest vestige of digestive organs at any developmental stage, the living worm must absorb all of its nutrients through its body surface. During life a very delicate balance is maintained between the fluids within the worm and those in the surrounding medium. As long as normal conditions are maintained, the body is flat and flaccid; when the living worm is removed to normal salt solution or water for microscopic examination, this balance becomes disturbed. Fluids pass through the wall, causing the body to become turgidly distended and circular in cross section. Many zoologists have failed to realize that this turgid state is due to a physiological response to abnormal surroundings and hence have classified Acanthocephala as "round" worms. Since the plumped condition is almost universally distinctive of all well preserved specimens, it should be maintained through dehydration and clearing after the specimens have been stained and prepared for microscopic mounts.

Alcoholic specimens are passed down the grades of alcohol to water and are then placed in a solution of approximately .25 per cent of trisodium phosphate in distilled water. Freshly preserved specimens become soft, pliable, and translucent almost immediately, while specimens that have become hard, brittle, and unyielding after long preservation may require several hours or even days in a warming oven before they attain the proper degree of softness and pliability. It is well to keep treated material under observation, since the use of too strong solutions of trisodium phosphate or weaker solutions over too long a time may render specimens too soft and jelly-like for easy handling. When the desired degree of softness and translucency has been reached, they should be removed to distilled water to check the action.

Specimens thus treated, washed in distilled water, and subjected to hematoxylin or borax carmine stain become much more brilliantly stained than untreated specimens. Furthermore, the treated specimens may be dehydrated, cleared, and mounted in clarite or damar without developing opacity except in rare instances. This treatment is far superior to the puncturing mentioned previously.

Specimens of Acanthocephala which have been completely dried for many years have been reclaimed by the foregoing process. In some instances, practically all details of internal structure became available in the stained mounts; in others, only structures like proboscis hooks and body spines. With preserved specimens which are shriveled and hardened the strength of the solution is increased. Worms which are fairly turgid in preserving fluid usually become soft and flaccid in trisodium phosphate. Later, when returned to water or alcohol grades, the turgidity reappears. One distinct advantage of the softening effect is the ease with which specimens may be straightened prior to dehydration. While softened, each specimen may be folded back and forth on a microscopic slide along strips of cardboard or toothpicks and may be slightly compressed and held in place by covering with another slide. Several wrappings of thread provide the pressure and hold the slides together so that the stained specimen may be carried in Coplin or Harvard jars through the grades of alcohol. In absolute alcohol the specimen becomes firm enough that it may be removed from between the slides and yet retain its series of folds, ready for clearing and mounting under a cover glass. Such a preparation may be "read" under the microscope in much the same way that series of sections are interpreted, without the confusion of parts usually encountered when long worms are broken into lengths suitable for mounting. Large worms intended for partial dissection to show internal organs are much more readily handled after treatment with trisodium phosphate.

No other detergent tried in this laboratory has given results superior to those obtained with commercial grade of trisodium phosphate, which has the distinct advantage of low cost and general availability.

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The Department of Astronomy of the University of Chicago

Robert M. Hutchins, *Chancellor*

MY ASSOCIATION WITH ASTRONOMY is an association with Otto Struve. I have never studied the subject and never attempted to understand it. I believed in Mr. Struve. I believed in his judgment of men, in his standards of scholarship, and in his aims for his Department. I was sure that he knew the difference between a first-rate man and a second-rate man and that he would not tell me a man was first-rate if he were second-rate. I was sure that he knew the difference between a big department and a great department and that he wanted a great one. He did not want a great department so that he could brag about it; he wanted it so that the members of the Department and the University could make the greatest possible contribution to the advancement of knowledge. I knew that when Mr. Struve made a financial recommendation, he was being as economical with the University's funds as I would be, and often more so.

All I ever did for Mr. Struve was to encourage him. He had the ideas and the plans. He had the intelligence and character that commanded my respect, even when I didn't know what he was talking about. The difficulties he encountered were many. It was necessary for him not only to reconstruct a department in the midst of the Great Depression but also to operate it at a distance from the University. For long periods he had to give up his research to see to the most harassing kind of housekeeping problems in Wisconsin and Texas. All I did was to tell him the truth—that he was doing a great job.

Under Mr. Struve's leadership the Department of Astronomy set new standards of research as well as new standards for the quality of the staff in the Division of the Physical Sciences at the University of Chicago. The record of the Department has been an inspiration to the whole University.

When the Depression arrived, we could all see that research was going to be hard hit and that research in fields not immediately practical was going to suffer more than any other kind. Research in fields which required vast expenditures for new capital equipment was going to be almost impossible unless universities could pool their resources. Mr. Struve was not alone in his interest in cooperation among universities. I was also interested in cooperation in astronomy because (1) I foresaw that we would lose him unless we could find him a place to look at the stars where he would have some chance of seeing them, and (2) I could not imagine where we would get the money to build an observatory under clearer skies.

By the time the McDonald bequest to the University of Texas was finally settled, Mr. Struve had built up a good Department of Astronomy. The University of Texas had none at all. At the suggestion of Mr. Struve and Dean Henry Gordon Gale I telephoned President Benedict at Austin and obtained his immediate consent to consider a proposal involving the combination of Texas' Observatory and Chicago's Department. Mr. Struve did the rest. The peaceful and prosperous relationship which Texas and Chicago have enjoyed for many years is a testimony to the possibilities of university cooperation—at least when Mr. Struve is the connecting link.

Mr. Struve has brought other universities into his orbit by making observing time available to them in Texas, and the end is not yet. The possibilities of cooperation with institutions which are without the funds required for a modern observatory are far from exhausted.

Under the leadership of Otto Struve the Department of Astronomy of the University of Chicago has made important contributions to the art and science of astronomy. It has given new impetus to research in its field; it has proposed standards for the emulation of scientific workers in every field; and it has demonstrated that universities can work together. This is indeed a great record.

To celebrate the 50th anniversary of the founding of the Yerkes Observatory and the American Astronomical Society, a special session of the Society is being held at Williams Bay, Wisconsin, site of the Observatory, on September 6. On this occasion the editorial office of *Science* takes pleasure in presenting a series of articles by those who have been intimately associated with the achievements of this great Observatory.

Some Reminiscences of the Yerkes Observatory, 1898–1904

Walter S. Adams

Director Emeritus, Mount Wilson Observatory

THE PERIOD OF 50 YEARS WHICH HAS elapsed since the dedication of the Yerkes Observatory has been one of transformation in much of the field of astronomy. It opened at a time when visual observations with telescopes were still a major factor in observatory activities, photographic methods were in their infancy, the spectrum was studied empirically, and cosmogony was almost a completely sealed book. The period ends with visual observations greatly reduced in amount, although still holding an important place, with photographic methods applied almost universally and enormously improved and extended, with the spectrum analyzed and used as an extraordinarily powerful tool to seek out physical processes in the sun and stars, and with a clear and logical picture of a physical universe beyond the imagination of the astronomer of 50 years ago.

The Yerkes Observatory has taken a notable part in these great developments. It was fortunate in having as its founder and first director a man of remarkable insight and initiative, with a clear understanding of the major problems of astronomy and an almost intuitive perception of the fields of investigation which would yield the greatest returns. Although primarily a solar physicist, George Hale always emphasized the place of the sun among the stars and the necessity for applying to the stars the knowledge derived from their nearest representative. So, we find during his years of directorship not only marked advances in the methods and instruments used for the study of the sun, but also developments in stellar research which have proved remarkably fruitful in later years. He was one of the first to recognize the possibilities of the reflecting telescope, then a much neglected instrument in the United States, for both direct photography and spectroscopy, and secured from his father the gift to the Observatory of the 60-inch mirror which was later used in the first large reflecting telescope on Mount Wilson. Hale also made a great advance in the application of powerful spectrographs to the photography of both solar and stellar spectra. Realizing that spectrographs attached to moving telescopes must necessarily be limited in size and length, he developed the coelostat and concave mirror into a standard type of telescope for solar observations, and planned the use of the coudé focus of large reflecting telescopes for corresponding investigations of stellar spectra.

In other fields Hale's contribution was equally important. He appreciated at once the advantages of photography with a long-focus telescope for measurements of stellar parallaxes and brought Schlesinger to the Observatory to use the methods he had developed in this fundamental but difficult branch of positional astronomy. He encouraged Ritchey to undertake photography through yellow color filters at the 40-inch telescope, a project which resulted in some of the finest photographs of the moon, star clusters, and brighter nebulae ever obtained. The 24-inch reflecting telescope was also built at this time, and in Ritchey's hands began, in friendly rivalry with the Crossley reflector of the Lick Observatory, to penetrate into the domain of the more distant nebulae. The fundamental work in stellar radial velocities, under the immediate direction of Edwin Frost, was supported strongly by Hale, and benefited greatly from his advice and optical and instrumental skill and knowledge. He also established a department of stellar photometry, in which Parkhurst carried on a long series of measurements of magnitudes of variable stars, and invited E. F. Nichols to attempt the radiometric investigation which resulted in the first successful measurement of the heat radiated by a star. Finally, Hale, who was a physicist at heart, carried out in the laboratory, either by himself or with collaborators, several spectroscopic investigations designed to imitate or help to explain phenomena observed in the sun and stars. The maintenance of such an intimate relationship between telescope and laboratory instruments operated under controlled conditions was a cardinal principle in Hale's scientific career.

It is clear from this brief summary that Hale had solved in a most efficient way the difficult problem of utilizing a large, existing telescope to the best advantage. In later years he was able to reverse the situation to a considerable extent, building instruments to fit the problems in mind, and his experience at the Yerkes Observatory then proved of the utmost value. We can readily understand, then, why Hale's colleague, Frost, could have given to the 40-inch refractor the title of "the busiest great telescope in the world." Used for solar observations during the day and for a wide variety of stellar investigations by night, the 40-inch telescope could well have carried above the entrance to its dome the sign on the doors of numerous Chicago saloons of those unregenerate days: "We have thrown away our keys. Open all the time."

My relationship to the Yerkes Observatory began in 1898 when, on the advice of Frost, who had been my teacher in astronomy at Dartmouth College, I undertook graduate study at the University of Chicago and spent some months at the Observatory in acquiring practical observing experience on the sun under Hale and in stellar spectroscopy under Frost. Soon afterward I went to Germany for study at the University of Munich, but after about a year the offer by Hale of a position as assistant at the Observatory led to my return in the early summer of 1901. I remained until May 1904, when Hale organized the first expedition to Mount Wilson.

The Yerkes Observatory was dedicated in October 1897, so that, when I first knew it as a student the following year, recollections of the occasion were fresh in the minds of everyone. These have been supplemented by an interesting book of records and clippings collected by Frederick Seares, who was present as a delegate from the University of California. This book, through his kindness, is now in the library of the Mount Wilson Observatory.

The dedicatory exercises occupied five days, the first three of which were devoted to meetings, addresses, and demonstrations of instruments and apparatus, primarily for the benefit of the visiting astronomers and other scientists. On the fourth day special trains left Chicago for Williams Bay, bearing Mr. Yerkes, President Harper, and the Trustees of the University, together with many city officials and other prominent citizens. The formal presentation of the Observatory and its acceptance were made on this day. The trains returned to Chicago late in the afternoon in time for an evening dinner tendered the visiting scientists by Mr. Yerkes, at which President Harper served as toastmaster. On the fifth and last day the buildings and laboratories of the University were inspected, the exercises closing with a reception to Mr. and Mrs. Yerkes and the delegates in attendance.

No one can look back upon this dedication without realizing how strong and genuine was the interest of the citizens of Chicago in this great gift to science. Some 800 persons attended the final exercises at Williams Bay, and all the Chicago newspapers carried long and detailed accounts of the day-by-day proceedings. They had good reason to feel that the new observatory was peculiarly their own. It was given by a Chicago man to a Chicago institution, and the man who was responsible for its establishment and was its first director was born and lived in Chicago. Naturally, the newspapers were not inclined to conceal these facts, nor did they fail to issue headlines which sound remarkably familiar even now. "Great Eye to Open," "Great Lens Focused," and "Feast of Wise Men" were some of the expressions which may well serve again at the dedication of the 200-inch telescope. Although the principal feature of the 40-inch telescope was correctly named on this occasion, astronomers know, to their sorrow, that it takes more than half a century to convince the average reporter of the difference between a lens and a mirror.

The chief interest in such an event consists in the men who were present, and numbered among them were nearly all those whose names were so familiar in astronomy at the beginning of the century: Hale, the man of 29, who had seen the first of his great dreams come true; Simon Newcomb, the rather grim dean of American astronomers; Keeler, whose brilliant career was so soon to close; Pickering of Harvard, with his diversified astronomical interests; two of America's distinguished physicists, Michelson and Henry Crew; Runge, the German spectroscopist; and the group of famous visual observers which included Barnard, Burnham, Comstock, Doolittle, and Ormond Stone. With such a variety from which to choose, the reporter, with his eternal desire for "human interest," had a field day, for the element of picturesqueness was by no means lacking. In particular he preyed upon Burnham, the great double-star observer, to whom Newcomb, in the course of his lecture, had paid a special tribute for his remarkable discoveries with small telescopes. Under the headline, "Burnham Is in Focus," the reporter pictured the unconventional Burnham on the stage at Newcomb's lecture as "a little man who wore neither gown nor cap, but dropped into his place, slid down to about the middle of his back, and folded his arms. . . . His face was thin and his hair seemed bent on going where the wind listeth (*sic*)." At Newcomb's reference to him the reporter said that "the little man seemed to slide down another inch in his chair and pull his arms into a tighter fold." As I came to know Burnham shortly afterward, the description seemed to me a fairly accurate one, with the possible exception of the last statement. At that stage in the lecture there is a strong probability that Burnham was asleep.

It was an interesting and highly individualistic staff that was gathered together at the Observatory in these early years. The vivid personality of Hale, with his eagerness and enthusiasm and a mind constantly searching for new methods and devices, was balanced by the more deliberate Frost, whose conservative judgment was the heritage from a long line of New England ancestors. Together they formed a most efficient combination, with Hale usually the originator of a plan and Frost the counselor and critic. This difference in outlook almost invariably assured a well-considered decision which had been judged from many points of view.

Barnard and Burnham were great figures in the field of visual astronomy, to which the science has been indebted for many of its most spectacular discoveries. Each was a master of that difficult instrument, the filar micrometer, but their temperaments were very different. Although a most active observer, Burnham was philosophical in his outlook: if a night was stormy or the seeing was impossibly bad, Burnham took the matter calmly; there was always a good book to read, or someone to talk to, or even a game of whist to play if sufficient players were available. Barnard, on the other hand, felt a sense of injury and would be in the depths of despair if the night was bad, or, conversely, would be on the top of the world after a clear night with good seeing. Barnard's absorption in his work was almost incredible. On a stormy night he would often go out into the rain every few minutes to observe the direction of the wind and the amount of rainfall in the hope of being able to predict a clearing. On clear nights he would be in the dome long before dark, observing some bright star or planet or glancing impatiently into the field of the telescope until his object became visible. He had many of the simple and lovable characteristics of a child, and it was a deep pleasure to me in later years to renew at Mount Wilson the warm friendship begun at the Yerkes Observatory.

The two other members of the staff with whom I was chiefly associated at this time were Ellerman and Ritchey. Ellerman had been an assistant to Hale for several years at the Kenwood Observatory and was a remarkably skillful and resourceful observer. His long experience with instruments made him invaluable in the adjustment and testing of the experimental apparatus which preceded the construction of more permanent equipment such as the Rumford spectroheliograph. He was an excellent photographer, highly competent with machine tools, and always ready to help visiting scientists who came to the Observatory for special investigations, or inexperienced students or assistants like myself, who were trying to gain some knowledge of observational astronomy. Ellerman had many outside interests such as music, tennis, golf, and swimming, and his attempts to stalk a wild goose with a rifle over the ice in the middle of Lake Geneva were a regular feature of the winter season.

Ritchey was a perfectionist in his methods of work and had a tendency to surround his optical figuring and his observing with a somewhat unnecessary atmosphere of secrecy and even awe. Nevertheless, his results were in general proportional to the care which he took. Several of his superb mirrors, together with the photographs which he made with the Yerkes Observatory instruments and in later years at Mount Wilson, bear witness to his skill and form a contribution of great and permanent value.

Without entering upon any detailed description of the work of the Observatory during these early years it may be of interest to comment briefly upon some of the more important investigations then in progress. Hale's primary interest was naturally in the spectroheliograph, which he had invented only a few years previously. His chief object was to explore the possibilities of this instrument in solar research, and with this in view he designed, after considerable experimentation, the Rumford spectroheliograph. As used on the 40-inch telescope, it proved remarkably efficient, enabling him not only to study the distribution of gases of various elements in the solar atmosphere through the use of their corresponding spectral lines, but also, in the case of calcium, to explore the distribution in depth by using different portions of the same line. The need of greater dispersion to exploit fully exacting observations of this kind led Hale to plan the coelostat type of fixed telescope with which spectroscopic instruments of any desired focal length could be used. There can be little doubt that the excellent photographs made with the Rumford spectroheliograph showed some traces of the vortical structure around sunspots, the full recognition of which at Mount Wilson led Hale to his remarkable discovery of the magnetic field of spots.

Solar spectroscopy, although necessarily limited by the length of the spectroscopes which could be attached to the large refractor, was also carried on successfully. The fine solar seeing often found at the Observatory, especially during the autumn months, led to the detection of the green carbon fluting in emission at the edge of the sun, and many other bright chromospheric lines were observed and listed. The lack of sufficiently powerful spectrographs, and the absence during these years of large sunspots because of the phase of the spot cycle, were responsible for the limit on the number of observations in this rich field of study.

In stellar spectroscopy chief emphasis was laid upon measurements of radial velocity, although the important investigation of Secchi's fourth type stars by Hale, Ellerman, and Parkhurst dealt largely with the physical aspects of their spectra. Considerable attention was devoted to the spectrum of Nova Persei, the brilliant nova of February 1901. It is interesting to realize that the large telescopes of the world are still obtaining important data on this nova nearly 50 years after its outburst. Frost wisely selected for intensive observation of radial velocity the relatively neglected class of B-type, or helium, stars. The lines in the spectra of these stars are usually diffuse, and several photographs were needed to provide a reasonably accurate value of the velocity. As a result, the number of stars observed increased but slowly. A discussion of the radial velocities of 20 such stars, published by Frost and Adams in 1903, showed clearly, however, that the average motion of these stars is exceptionally small, a conclusion which has proved important in later discussions of stellar motions. Numerous spectroscopic binaries were discovered in the course of these observations.

The micrometric observations of Barnard during these years ranged over a wide field, from measurements of the diameters of the major and some of the minor planets to the enormous labor involved in the triangulation of many stars in globular star clusters. The extraordinary accuracy of these visual measurements has always been a source of wonder to astronomers, and he was well named "Barnard of the wonderful eyes." His determinations, for example, of the parallax of 61 Cygni and of the positions of Eros compare favorably with the best photographic results. My most interesting experience with Barnard's observing occurred on one fine summer night when I looked in at the dome of the 40-inch telescope and found him measuring the position of the fifth satellite of Jupiter, which he had discovered at the Lick Observatory some years earlier. This is a difficult object because of the glare of the great planet, and many astronomers have never even seen it, but Barnard was measuring it steadily as it moved outward toward elongation and then turned back again. Time was valuable, and I volunteered to record his measures so that he would not have to remove his eye from the eyepiece more often than necessary. The figures slowly increased, became stationary, and then began to decrease. The following day Barnard showed me a curve on which the measured values fell almost as closely as if they had formed a part of the curve itself. The fact that Barnard, at the height of his observing powers, time and again observed the planet Mars under the best of conditions with telescopes of various apertures, and could never detect the very fine markings described by Lowell and a few others, would seem to provide the most conclusive evidence bearing on this vexed question.

Burnham was also an extraordinarily able visual observer but did not have Barnard's catholic interest in almost every object in the sky. He lived exclusively for double stars, and there is a tradition that one day he mentioned casually to Barnard having seen a comet in the field of one of his double stars on the preceding night, but he had not measured its position. The comet was a new one, and Barnard's horror can well be imagined. Burnham was an inveterate cigar smoker, and on the morning following a night's work a fairly accurate analysis of his observing schedule could be made from the intricate trail of tobacco ashes on the floor of the dome. On one occasion his smoking habits resulted in a fire in his office which partially burned the couch on which he was taking a nap. Burnham was a delightful companion, and on stormy nights two or three of our younger group would often gather in his office to listen to his stories or to play a game of whist, of which he was very fond. Mrs. Frost occasionally visited us to form a fourth player at the table.

Burnham's observing nights were always at week ends, since he served as a district court reporter in Chicago during the other days of the week. An unfailing sign of his coming, for which we used to watch eagerly, was the arrival at the Observatory of a case of Burgundy. Whether his taste for wine was acquired during his years in California, whether it was due to the fact that the water of Chicago at that time often had to be boiled, or whether it formed part of his general Bohemian instincts we never knew.

The pioneering work of Schlesinger in developing methods and placing on a firm foundation photographic determinations of stellar parallax, visual photometric observations of variable stars by Parkhurst, and various laboratory investigations, mainly spectroscopic in character, completed most of an active and productive program during these years. The radiometric measurements by Nichols of the heat radiation from Arcturus, Vega, and two of the planets, made in the summer of 1900, attracted much attention from scientists. It is interesting to note that these first results obtained in a difficult field show the marked difference in the amount of heat radiated by Arcturus and by Vega, two stars of nearly the same apparent magnitude. An amusing incident occurred during these observations. Charles St. John, then, I believe, on his first visit to the Observatory, was assisting Nichols in the adjustment and calibration of the radiometer, using for the purpose a candle flame in a field west of the instrument and about a quarter of a mile distant. Suddenly the vane of the radiometer rotated violently, and the spot of light used for measurement leaped completely off the recording scale. St. John had brought his beaming face into the path of light and had obtained a physical measure of his unfailing good nature.

The younger group at the Observatory during the last years of my stay included Philip Fox; Herbert Reese, later professor of physics at the University of Missouri; and Street, who assisted Ritchey in the optical shop. We were all of nearly the same age and lived at Mrs. Sawyer's house on the main road leading to Williams Bay. Miss Ware took her meals with us and had a most beneficial and civilizing influence upon a lively group, of which Fox was naturally the ringleader. R. James Wallace, known, of course, as "Hoot," and his family lived next door and was a close and always entertaining friend. Under such conditions and with the hospitality of the Frost, Barrett, Schlesinger, and Wallace houses available, we had the best of times together even in the comparative isolation of a small community in a Wisconsin winter.

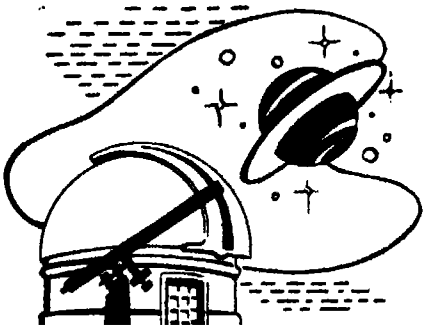
As might be expected, the members of our group were usually engaged in trying to get the best of one another, and Fox was a master at the game. So Reese and I felt a grim satisfaction one Saturday evening in the fall of the year when Fox and Street, who had been absent all day, arrived at the house, limping, somewhat battered about the face, and extraordinarily uncommunicative. Some time before, we had been discussing the subject of football games between teams of rival high schools in southern Wisconsin, and Fox and Street, the athletes of our group, had announced that it would be most amusing and entertaining to join one of these teams and show its opponents how the game should be played. This was quite possible, since eligibility rules were unknown or remarkably elastic, to say the least. Reese and I had pretty much forgotten this conversation, but it seems that Fox and Street had selected this day and offered their services to a high school about 30 miles from Williams Bay. They were accepted without difficulty, but unfortunately the opposing team had gone them one better and negotiated with several husky mill hands in a neighboring steel factory. It took a long time to pry out of Fox the score of the game.

On another occasion Street was again a victim and Fox and I were the perpetrators, taking shameful advantage of Street's lack of knowledge of the constellations. One very cold winter night when Fox and I were at the Observatory a telegram arrived, announcing the discovery of an 8th magnitude nova. We visited the dome, where we found Frost, I believe, considering the possibility of observing the star with the smallest spectrograph available. After some time we went home, awakened Street, and gave him the news, carefully omitting any reference to the star's brightness. Street was greatly excited and asked where it was, whereupon we pointed to the brilliant Procyon, riding high in the winter sky. "Gee," shouted Street, hurried on his clothes, and started for the Observatory along the path through the snow. Fox and I went to bed after safely locking our doors.

The lake and golf were naturally the chief centers of our outside interests at the Observatory. Once Fox and I made a trial swim on the day after the ice went out, but this experience was not repeated. Several of us tried to swim across the lake, but Fox was the only one to succeed, the coldness of the water discouraging those of lesser strength and endurance. The good ship *Argo*, a small sailing boat, was for some time the proud possession of Fox and Street, but not being expert sailors and having had to swim ashore a few times after capsizing in uncertain winds, they gradually lost interest in their venture and left to others the search for the Golden Fleece. The beauty of Lake Geneva in all its different aspects is one of my choicest memories of the years at the Observatory.

The golf course in its original form consisted of 6 holes laid out in the fields north and west of the great dome. There were no formal bunkers or traps, since the character of the course offered plenty of natural difficulties and hazards, consisting, as it did, of roughly mown hay fields with occasional bushes and thickets. The group with which I usually played included Hale, Frost, and Ellerman, and I remember our games together mainly because they brought out so clearly the individual characteristics of the players: Hale, with his eagerness and zest, making many fine strokes but occasionally "pressing" through overenthusiasm; Frost, deliberate and calm, stamping on the ground before a drive until he had settled his long frame into the most comfortable position; and Ellerman, who was normally our best player, studying his strokes with great care and usually executing them equally well. It was Ellerman who painted his golf balls red in order to play over the hard snow in winter, and who once amused himself by making a drive approximately half a mile long over the glare ice of Lake Geneva.

In assembling these scattered reminiscences of the early years of the Yerkes Observatory I have tried to give a picture, however slight and inadequate, of the individuals who made up the small group which started the Observatory upon its scientific career. The years were difficult ones financially, and auxiliary equipment was scanty and hard to obtain. Seen from the present point of view, a few of the problems investigated do not appear of the first importance; for physics, if not in the dark ages, was at least static, with the renaissance yet to come, and the means for interpreting the results of observation were still hidden from view. Nevertheless, the group of those years was an active one and had a leader of great vision and insight who prepared for what the future might bring; the able and highly trained staff of the present day, with greater instrumental resources and all the recent developments of modern science at its command, has shown brilliantly how great a structure may be erected upon the foundations laid half a century ago.



Studies of the Stellar System

G. P. Kuiper and W. W. Morgan

THROUGHOUT THE FIRST 50 YEARS OF the Yerkes Observatory investigations on galactic structure have been carried out on a substantial scale. Some of the principal efforts are described below.

The knowledge of our stellar system at the beginning of the century was only rudimentary. It was assumed from star counts to the 10th magnitude that the galaxy was a flat, disk-like system with the sun roughly at the center. But the overwhelming majority of the stars are fainter than the 10th magnitude. In fact, if all stars brighter than the 10th magnitude were eliminated, the Milky Way would not appreciably change its apparent shape and brightness; only the bright stars dotted on the luminous background would be missing.

One might suppose that, if star counts were made to the 18th instead of to the 10th magnitude, in fields properly distributed over the sky, the true picture of the galaxy would emerge. This approach was advocated by Kapteyn in 1904 in his Plan of Selected Areas, and the observations accumulated since then at several collaborating observatories have indeed led to a far more precise and complete outline of the galaxy. But progress in the interpretation of these star counts was seriously hampered by the lack of knowledge of so-called interstellar absorption. In fact, the first results based on counts to the 18th magnitude, made on the assumption that interstellar absorption was not important, have proved to be seriously wrong.

The Milky Way studies of Barnard and Ross at the Yerkes Observatory are complementary to the studies of the smoothed-out galaxy of the Selected Areas school. Barnard, in his beautiful *Atlas of selected regions of the Milky Way*, published by the Carnegie Institution of Washington in 1927, has shown the Milky Way to consist of a highly complex array of star clouds and dark markings. His efforts were a continuation of his earlier work at the Lick Observatory between the years 1892 and 1895 (Lick Publication 11, 1913) and owe their success to the gift by Miss Catherine Bruce, in 1897, which enabled Barnard to acquire a 10-inch "portrait lens," as he preferred to call it, figured by the great optician, Brashear. Ever since its completion in 1904, the Bruce telescope has aided the Yerkes astronomers in their galactic studies.

The tradition of high-quality Milky Way photography set by Barnard was continued by F. E. Ross. Ross had introduced into astronomy a new tool, the "Ross lens," an F/7 system with superb field qualities. With a 5-inch lens of 35-inch focus he obtained a set of extraordinarily fine negatives which have been reproduced in the Ross-Calvert *Atlas of the northern Milky Way*, published by the University of Chicago Press in 1934.

Both atlases are based on plates obtained by their authors largely at other observatories, notably Mount Wilson, and are fine examples of the value of interinstitutional cooperation.

Barnard's work with the Bruce telescope included one other program that has been a rich source of astronomical results. He covered a large part of the northern skies with first-epoch plates for subsequent proper-motion surveys with the aid of the blink microscope. The remarkable star, BD +4°3561, which carries Barnard's name, still holds the record in the amount of its proper motion (10ʺ.3 per year). Barnard's star, discovered in 1916, must have been a great stimulation for the completion of this program.

The proper-motion program was taken up by Ross after Barnard's death (1923). With great care he duplicated the Barnard fields and embarked upon the arduous task of examining the millions of faint stars on the plates for proper motion. The search was completed in about 8 years, during which well over 1,000 stars with large proper motion were announced. Among these Ross stars are some of the most interesting and faintest of the sun's neighbors in space. They have been a fruitful program for parallax determinations and statistical studies of the stellar population of the galaxy.

On a much smaller scale proper-motion searches have been carried out also on fields photographed with the 24-inch reflector. The first-epoch fields were taken for the study of variable stars, mostly by Parkhurst, and more recently for comets and asteroids, primarily by Van Biesbroeck. In 1916 Hubble repeated some of the former fields, as did Luyten and Ebbighausen more recently; while Van Biesbroeck quite recently duplicated many of his comet and asteroid fields. In all, an appreciable number of stars with large proper motion were found; the precision of the results was considerably higher than those obtained with the Bruce telescope.

The large collection of proper-motion plates in existence at the Yerkes Observatory has been the incentive for the compilation by Kuiper of a manuscript catalogue of all stars with proper motion larger than 0ʺ.3. Photographic observing charts were made by Kuiper and Miss Calvert for some 3,000 stars, all of which were observed for spectral type at the Yerkes and McDonald Observatories. Over 9,000 spectra were obtained which are used for the determination of spectral parallax and which, together with magnitude determinations, form an adequate foundation for the determination of the distribution of stars in the spectral type-magnitude or Hertzsprung-Russell diagram. If the distribution in this diagram is put on a numerical basis, it expresses better than any other diagram or table our information on the stellar population in space.

A final source of studies in proper motion, which has hardly been exploited so far, is found in the many excellent photographs of clusters taken with the 40-inch telescope. Both Ritchey and Barnard left many excellent negatives of globular and galactic clusters which are now invaluable because of the large scale of the 40-inch telescope and because of their age (many of them over 40 years). Some negatives have been recently duplicated and measured by Ebbighausen, but the greater part of this source of information is as yet untouched.

The importance of the proper-motion and subsequent parallax programs is not limited to the statistical data summarized in the Hertzsprung-Russell diagram. These programs are also basic for our information of stellar masses and absolute magnitudes (or luminosities). Together with data derived from eclipsing variables which can be observed spectroscopically, the parallax program, as applied to visual binaries, provides the basic data for the study of the mass-luminosity-radius relations. As such, they are fundamental for the present theories of stellar constitution and of energy generation. One important aspect of this work is the determination of mass ratios in visual binaries, which has been a subject of continuous study at the Yerkes Observatory for at least 30 years.

Mention should be made in this connection of a field of intensive activity throughout the Observatory's history—the observation and cataloguing of double stars. In the first two decades Barnard and Burnham contributed large numbers of observations to this field, and Burnham laid a foundation for all modern work on double stars by issuing his two-part *General catalogue of double stars within 121° of the North Pole* (Carnegie Institution of Washington, 1906). Later, this was supplemented by his *Measures of proper-motion stars* (Carnegie Institution, 1913). From 1916 to the present date, Van Biesbroeck has continued the tradition and has accumulated a great number of measures on many pairs of interest. Still more recently, Kuiper has paid special attention to pairs of importance for the mass-luminosity relation and has found a number of new objects in this class. The 40-inch telescope is equipped with an excellent micrometer, and the instrument as a whole is perhaps the best telescope of its kind for general double-star work.

Contributory to the study of the near-by stars have been important lists of radial velocities by Popper and Münch and of magnitudes by Seyfert.

Another kind of work now in progress with the 40-inch telescope is a program of spectroscopic absolute magnitudes and distances of the brighter stars, being carried on by Morgan and Bidelman. Among the most interesting types of stars for which information on the distances is being obtained are the luminous blue supergiants; these—even when apparently bright—are located at very great distances and thus allow us to obtain information concerning the absorption of light in space. Developments in methods in the course of the past few years now make it possible for us to determine the true brightness and distance of almost any kind of star now met with; the exceptional objects which cannot be dealt with directly form a vanishingly small percentage of the total number of stars which can be observed spectroscopically. Additional examples of these relatively rare, peculiar objects are being discovered in the course of the general spectroscopic program, and several remarkable and puzzling stars have been discovered recently by Bidelman. This research program therefore has a double result: the true luminosities and distances of the "normal" stars are being determined, and peculiar objects requiring investigation of an astrophysical nature are being discovered.

An entirely different field of galactic research, though connected with the pioneer work of Barnard, is that on the galactic nebulae. These studies have been important both for the distribution of nebulous material in the galaxy and for the scattering properties of such material. The research was carried out by Struve, Henyey, and Greenstein, after some remarkable early work by Hubble. In the course of this work Struve developed a novel instrument, the nebular spectrograph, which was first mounted on the 40-inch telescope and later transported to the McDonald Observatory. With it, extensive regions were found in the galaxy showing H_α in emission. Another notable contribution was the discovery by Elvey of the "galactic light," a dim reflection by interstellar material of stellar light falling on it. It was found as a residual brightness of the Milky Way after subtraction of all light attributable to stars.

A field of great promise lies in the application of the modern RCA photomultiplier tubes to astronomy. The Yerkes Observatory is participating in this development through the work of Hiltner, who has been observing eclipsing binaries of special interest.

Astrometry

G. Van Biesbroeck

THE CONTRIBUTIONS OF THE YERKES Observatory to astrometry were influenced during the first years by the two outstanding visual observers who joined the original staff. The first, S. W. Burnham, was at that time the recognized leader in the field of double stars. He discovered a great number of interesting pairs, the components being either very close or very unequal in brightness, and he used the 40-inch telescope to its full power to follow the orbital motion of the more difficult pairs. His monumental *General catalogue of double stars*, published by the Carnegie Institution in 1906, remained for many years an indispensable tool for all workers in that field. Since his retirement in 1915, the work on double stars has been continued by G. Van Biesbroeck, G. P. Kuiper, and, lately, D. Harris. This work has been the basis of most orbital computations done on visual binary stars in the last score of years. A large amount of micrometric work on double stars has also been done with the 82-inch McDonald reflector by Van Biesbroeck and Kuiper.

The second early observer, E. E. Barnard, had a much wider field of interest than Burnham. His enthusiasm as an observer established at the Yerkes Observatory the tradition of all-night work and of the utilization of every minute of available clear sky. He devoted the major part of his time at the telescope to the measurement of the relative position of stars in clusters in the hope of establishing internal motions in such systems. This was started at a time when it was not realized that photographic processes were infinitely superior to visual micrometric triangulation for that type of work and when no information was available concerning the great distances of clusters and the extremely slow motions to be expected in them. In Barnard's hands the micrometer was used more profitably in many other lines: he measured the diameters of planets, asteroids, and satellites; he followed the relative positions of Saturn's satellites and contributed many measures of the positions of comets as well as nebulae. He never failed to record the elongation of Jupiter's fifth satellite, the small body discovered by him in 1892 at the Lick Observatory.

The possibility of using the 40-inch telescope as a photographic instead of a visual instrument was not foreseen when it was first put in operation. At about the turn of the century Ritchey showed that by working in yellow light, for which the telescope was achromatized, excellent photographic images were given. For the best results this required the combination of isochromatic plates and a yellow filter as well as the double-slide guiding plateholder. The large scale given by the 62-foot focal length of the big lens procured a means of measuring positions with a precision never before attained, and at once the problem of stellar distances was inaugurated. On a grant from the then newly-established Carnegie Institution, F. Schlesinger spent the years 1903–1905 at Williams Bay, developing the method and investigating exactingly the precautions to be used in this most delicate operation. He obtained parallaxes for 27 stars, and the result was so successful that it marked the opening of a new era in astronomy. Up to that time only a handful of stellar distances had been obtained, none of which was too reliable. The gain in precision and speed with the new method made it possible to reach many stars and much greater distances. After Schlesinger left, the work was continued successively by Slocum and Mitchell, Lee, Joy, Van Biesbroeck, Mrs. Pettit, Moffit, Hetzler, Titus, and, after an interruption by the World War, Strand and Hall. Several other observatories joined in the campaign of measuring stellar distances after Schlesinger standardized the method of procedure. During the first third of this century several thousand stellar distances became thus available. Indirect methods calibrated by the photographic determinations allowed thousands of stars to be investigated for distance. Thereby the basis was laid for our knowledge of stellar luminosities and masses, for our modern concept of the size of the visible universe, and for far-reaching consequences in all branches of astrophysics. At present, stellar parallaxes are no longer determined wholesale with the 40-inch lens; the work is concentrated on a special group of stars, mostly faint, which have been shown by indirect methods to be at a measurable distance. The photographic process at the 40-inch refractor has been used in several other astrometric investigations: in the determination of mass ratios of binary stars (Van Biesbroeck, Huffer, Strand, Hall), in proper-motion work in the Kapteyn areas centered at +45° declination (Lee), and for the precise measurement of wide double stars by Hertzsprung's method (Strand).

The 24-inch reflector, which had been used mainly for photometric observations by Parkhurst and for studies on nebulae by Ritchey and Hubble up to 1922, has since proved increasingly useful for photographic astrometric work on faint objects: comets, asteroids, satellites, and proper-motion stars. With its aperture ratio of 1:4 it is a fast instrument photographically. It records in 5 minutes the faintest objects that can be seen in the 40-inch refractor. Many positions of asteroids fainter than are generally observed have been obtained with the 24-inch reflector by Van Biesbroeck, Struve, Chang, and, more recently, Harris. By repeating the earlier exposures with this instrument, the changes in star positions after an interval of more than a quarter of a century can be found by the "blinking" process. Van Biesbroeck has detected many faint proper-motion stars in this way. The same observer has published long series of comet positions obtained photographically with the 24-inch reflector; in order to improve the orbits of these objects it is essential that they be followed over as long an arc as possible. Measures of comets have often been continued for months with the 24-inch reflector after most observers abandoned them because they were too faint. Such extended series are especially valuable in distinguishing between parabolic or slightly hyperbolic orbits and the elliptic ones which indicate periodicity.

The brightnesses of comets and their puzzling fluctuations also constitute studies from these photographic documents.

Stellar Spectroscopy

Otto Struve

ON THE WALL OF THE DIRECTOR'S office hangs an autographed portrait of Sir William Huggins. Once the personal property of G. E. Hale, it was presented by him to the Yerkes Observatory at the time of his departure for Mount Wilson in 1904. Huggins was probably the most famous of the early pioneers in astrophysics. In 1856 he had built a private observatory in the garden of his London residence at Tulse Hill, and had engaged in the study of the spectra of the stars by means of a small visual spectroscope attached to a moderately large refracting telescope. Three years later, Kirchhoff had succeeded in reversing two strong, dark absorption lines of the spectrum of the sun by placing a flame colored by sodium vapor in front of the slit, so that the lines appeared as two yellow emissions on top of the usual background of the continuous spectrum. The intensity of the background spectrum of the sun was reduced by a filter in this experiment. When Kirchhoff removed the filter, allowing full sunlight to fall upon the slit, the two lines were again seen as black absorption features "with an extraordinary degree of clearness.". His announcement of the solution of the mystery of the Fraunhofer absorption lines followed shortly thereafter, and it was this announcement which inspired Huggins to write:

> Here at last presented itself the very order of work for which in an indefinite way I was looking. . . . A feeling as of inspiration seized me: I felt as if I had it now in my power to lift a veil that had never before been lifted; as if a key had been put into my hands which would unlock a door which had been regarded as forever closed to man [from Macpherson's *Makers of astronomy*, Oxford Univ. Press, 1933, p. 167].

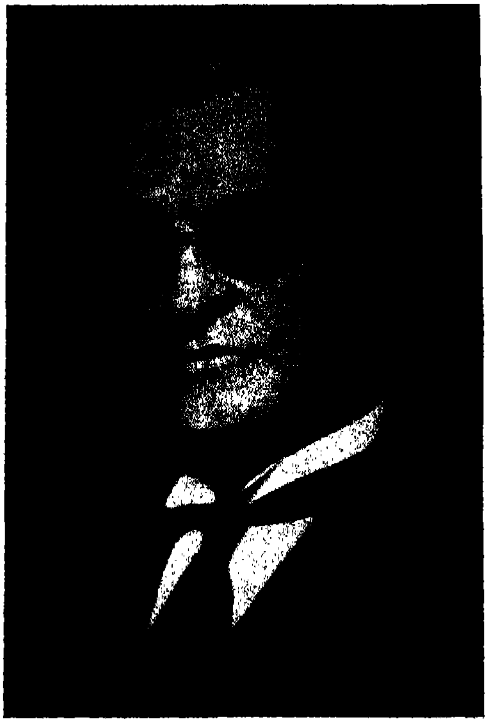
During the past 50 years three directors of the Yerkes Observatory have conducted their work under the watchful eyes of Sir William, and I believe that all three have often looked up to his portrait for guidance. My predecessors, Hale and Frost, had known Huggins personally, and his influence is easily discerned in their publications. My own work, though not so intimately connected with that of Huggins, unquestionably resembles his in character. Huggins was filled with the spirit of exploration. When he opened the dome of his observatory and took his seat at the eyepiece of his spectroscope, he entered on a perilous journey to distant worlds where only ingenuity in reading and understanding the records of his instruments could save him from wrong conclusions, and where great perseverance was needed to try again and again to solve those riddles of the universe which would not easily give up their secrets. The major part of the Yerkes Observatory's contributions to stellar spectroscopy has been obtained in a similar spirit of exploration. Our procedure has usually been to examine with the utmost care all stellar spectrograms at our disposal and to try to detect those features which were not already explained by existing theories. Less often our search would be guided by previous theoretical considerations. Having found and described a hitherto unexplained phenomenon, we would next look for related data and then, if possible, measure some recognizable characteristic feature of the new phenomenon as a function of the related characteristic. Our purpose would always be to find a physical explanation. More often than not, the true explanation would escape us time and again, so that the work would have to be laid aside until an advance in a different field would make it tempting to try again.

We have always recognized the importance of long routine programs in astronomy, such as the construction of great catalogues of star positions, of magnitudes or of radial velocities; we have taken some part in programs of this kind, but we must now recognize that our contributions to such large-scale program work have been relatively slight. In stellar spectroscopy we are the successors of Huggins, not of Secchi with his famous catalogue of stellar spectra or of Vogel with his great and systematic work on stellar radial velocities.

When Hale prepared the plans for the Yerkes Observatory, he included in the specifications a stellar spectrograph for the 40-inch telescope. He was primarily interested in the physical study of the sun, but he undoubtedly wanted to supplement his solar investigations with the study of stars of similar characteristics. The outcome of this plan was an important memoir, *The spectra of stars of Secchi's fourth type*, which was published by him, in collaboration with F. Ellerman and J. A. Parkhurst, in 1904, as Part 5 of Volume II of the Publications of the Yerkes Observatory.

Few astronomers nowadays are acquainted with the classification of stellar spectra by Angelo Secchi, who recognized four main classes. Those having strong hydrogen lines were assigned to class I (now designated O, B, and A). Spectra with weak hydrogen and strong lines of elements like Fe I and Fe II, Ca I and Ca II, etc., were assigned to class II (now designated as F, G, and K). The red stars formed classes III (now designated as M) and IV (now designated as N). Hale had been much attracted by the early work of Huggins, Vogel, and others, which had seemed to indicate that Secchi's series of spectral classes represented an evolutionary sequence. The sun belongs to class II. Through the gradual loss of heat it would be expected to become redder. Will it ultimately become a star of class III or of class IV? It was not clear at that time whether classes III and IV represented successive stages of development or two parallel branches. All stars of class IV are fainter than magnitude 5, and little was known concerning their spectra. Hale and his collaborators decided to make use of the great light-gathering power of the 40-inch telescope to obtain spectra of reasonably good definition. The results of the observations, all of which were carried out between January 1898 and November 1902, were exceptionally valuable, and the illustrations which Hale included in his publication rank even now among the finest ever secured. For example, the authors succeeded in photographing the violet region of the spectrum in the neighborhood of Ca II 3933 in the star 19 Piscium—a feat which even today can be duplicated only with very few of the world's largest telescopes. The conclusion was that classes III and IV are parallel sequences, both leading back to stars like the sun. This conclusion has since been confirmed by many independent investigations.

George Ellery Hale, 1868–1938



Edwin Brant Frost, 1865–1935

The old Brashear spectrograph, with which Hale's work on the red stars had been carried out, was in many respects unsatisfactory. Its prism supports were not sufficiently rigid, so that small changes in the flexure of the instrument would take place during the long exposures required for the fainter stars. There was no temperature control, and the dispersion of the prisms could change appreciably during a single exposure. Attempts to use this instrument for the determination of stellar radial velocities were unsuccessful. For example, the well-known standard velocity star ε Leonis, as photographed on 17 occasions between February 11 and April 25, 1900, gave velocities ranging from −10 to +13 km./sec. This at first led to the belief that ε Leonis varied in radial velocity, but it was afterward shown that the star has an apparently constant radial velocity of about +5 km./sec. Hale pointed out that on many occasions the spectrograph gave excellent results, but it was not dependable and could not compete with instruments used at other observatories.

The greatest advance in perfecting the spectrographic equipment for radial-velocity work had been made a few years earlier by W. W. Campbell at the Lick Observatory. His famous Mills spectrograph was capable of producing spectra with an average dispersion of the order of 10 A./mm. Stars with sharp and strong lines whose laboratory wave lengths were accurately known could be measured with a precision of the order of ±0.1 km./sec. This was an enormous gain over the earlier work of Vogel and Scheiner at Potsdam. It has only recently been surpassed by measurements at the Mount Wilson Observatory on photographs taken with the large, stationary spectrograph at the coudé focus of the 100-inch telescope.

In 1898 Hale obtained a grant from Miss Catherine Bruce, of New York, which enabled him to appoint E. B. Frost, of Dartmouth College, as professor of astrophysics at the Yerkes Observatory and to furnish sufficient funds for the construction of a new spectrograph for accurate radial-velocity work. The instrument made use of three large prisms of Jena flintglass, figured by Brashear in Pittsburgh. The collimator, having an aperture of 51 mm. and a focal length of 1 m., was specially designed by Prof. Hastings to be used in connection with a correcting lens, placed in the cone of rays from the 40-inch objective, in front of the slit, whose purpose it was to convert the visually corrected telescope into one with a color curve having a flat portion in the violet region of the spectrum. Two cameras were provided having focal lengths of 449 and 607 mm., respectively. The mechanical supports were built of strongly reinforced steel, and, following the example of the Lick Observatory, the spectrograph was attached to the telescope near the center of gravity of the former—a procedure which greatly reduced the danger of flexure.

The Bruce spectrograph was placed in operation late in 1901. It has remained in constant use for 46 years, but the optical parts have been changed from time to time, and provisions were added to use it with either one or two prisms. The linear dispersion on the plate is 10 A./mm. at λ 4,500 when used with three prisms and with the longer camera. Tests by Frost and Adams indicated that the precision of their radial-velocity measurements was quite similar to that obtained by Campbell at the Lick Observatory.

Frost's first work with the Bruce spectrograph dealt with the motions of the helium stars. Because many bright representatives of this class are located in the constellation Orion, they were designated by Frost as stars of the Orion type. Perhaps the fact that Hale was concentrating upon stars at the end of the evolutionary sequence, as conceived by Huggins and Vogel, induced Frost to give his attention to those objects which "seem unquestionably to occupy a position very early in the scale of evolution." In the half century which has elapsed since then, our ideas of stellar evolution have undergone many changes. We no longer think of the helium stars as forming the beginning of the cycle and the red stars as forming the end. But in many respects these two groups are still recognized as extreme opposites in temperature and in other physical characteristics.

Together with W. S. Adams, Frost published a paper under the title "Radial Velocities of Twenty Stars Having Spectra of the Orion Type." Although the number of stars was not sufficient to make a solution for the motion of the sun in interstellar space, "the distribution of positive and negative velocities shows clearly the direction of the motion of the sun in space." The average motion of a helium star was found to be surprisingly small—only 7.0 km./sec. It was already known from the work of Campbell and others that the average velocity of the cooler stars is considerably larger. Thus, Frost and Adams brought out the significant fact that the average motions of the stars are not the same for all spectral types. This result has been of fundamental importance in all later investigations concerning the dynamics of the stellar system.

A very puzzling result was stated by the authors in the following short sentence: ". . . if the sign be regarded, the mean becomes +4.6 km./sec." In other words, after the component of the solar motion had been subtracted from the measured radial velocities, the mean velocity was not zero, or close to zero, but was of the same order of magnitude as the mean velocity taken without regard to sign. The authors had thus, for the first time, recorded the famous K-effect in the motions of the helium stars, which, literally interpreted, means that the system of these stars, as a whole, expands with a velocity of 4.6 km./sec.

In 1910 Frost, in collaboration with J. C. Kapteyn returned to the question of the mean motion of the helium stars. After having discussed the solar motion from the large amount of material collected by Frost, the authors remark:

> . . . meanwhile our numbers bring out a somewhat unexpected fact, namely, that the velocity of the sun relative to the stars near the apex is found to be very different from that relative to the stars near the antapex. To show this more clearly, a separate solution was made for the stars for which λ < 90° and for which λ > 90° (λ is the angular distance of a star from the apex, that is, from the point in the sky towards which the

> solar system is moving). We thus find:
>
> Near apex v = 18.38 ± 1.40 km./sec. from 32 stars
> Near antapex v = 28.38 ± 1.36 km./sec. from 29 stars
> Simple mean v = 23.38 .... from 61 stars
>
> The difference is very considerable and cannot well be attributed to accidental error alone.

It would seem that in the direction in which we are moving we are approaching the stars less rapidly than we are receding from the stars located in the opposite direction. This would not be possible if the stars were, on the average, stationary. They must have a systematic motion, and this can best be described as a general expansion in all directions. The nature of this expansion has been the subject of many later investigations. Frost, himself, spent much time and effort in proving that it could not be due to errors in the assumed stellar wave lengths, which were then known with insufficient accuracy. Later workers attributed it to a spurious effect caused by a cluster of helium stars in the Scorpius-Centaurus region, which all move in the same direction. Still others have thought of a gravitational red-shift, a phenomenon which may well be present in the most massive stars of very high temperature whose radii are not particularly large. The problem which was opened by Frost and Kapteyn is still unsolved.

In the course of Frost's radial-velocity work on the stars of early spectral type, many new binaries were discovered. These objects show variable radial velocities, and sometimes their lines are double—corresponding to the opposite motions of the components in a close double-star system. The pages of the *Astrophysical Journal* were virtually swamped with announcements of new binaries. Their number grew so rapidly that Frost was, at times, concerned over the question whether enough stars of constant velocity would be left to provide sufficient material for the statistical study of the motions of the helium and hydrogen stars. He and his associates, therefore, began the laborious task of determining the orbits of some of these binaries. Only in this manner could the average systemic velocity of a close double star be determined.

On May 14, 1902, Frost made a discovery of great importance. On that particular night he obtained two spectrograms of the bright helium star, β Cephei. He had observed it on many previous occasions and had found the velocity to vary as in a spectroscopic binary. But all efforts to find a period within the usual range of a few days to a few weeks had failed. He states in his first announcement concerning β Cephei:

> We had assumed from the first plates that the period would be rather long, but a suspicion to the contrary led me to take two plates on the night of May 14, and during the interval of five and one half hours the velocity changed 14 km., or nearly half of the whole range so far observed.

Such rapid variations in velocity were a sensation in 1902, and Frost diligently continued his observations. Four years later he announced that the period is $4^h34^m11^s$, and that the velocity curve is nearly symmetrical, with a range of 34 km./sec. He tried to determine a set of orbital elements, in the conventional manner, and found that the radius of the projected orbit would be unbelievably small—only 45,000 km. Later investigations at the Yerkes Observatory, including one completed in 1947 by Miss Nancy Roman, show that β Cephei is not a real binary, but a star of other and, in many respects, unique physical properties. We still know little concerning the cause of the variations in radial velocity; perhaps they are produced by some kind of pulsations, as in the Cepheid variables. Another interesting representative of this class of stars, β Canis Majoris, has been investigated by Swings and the writer and more recently by Miss A. Underhill. It shows remarkable, and as yet unexplained, periodic variations in the profiles of the absorption lines (first discovered at the Lick Observatory).

The last years of Frost's administration were clouded by his blindness. He lost the sight of one eye, through the loosening of the retina, while working with the 40-inch telescope. A rapidly growing cataract in the other eye in 1921 ended his scientific work. He retained the directorship until 1932, but he was no longer able to take an active part in the research work of the Observatory.

The original equipment of the Observatory was unquestionably the best that could be obtained at that time. But severe financial restrictions throughout most of Hale's and all of Frost's administrations made it impossible to maintain the equipment on the high level that was required to meet the competition of other institutions. The Yerkes Observatory gradually fell behind, and the work slowly assumed a more routine character. It was at this stage that, through the initiative of President R. M. Hutchins, a new era of development and expansion was started. In 1932 Frost retired, and the writer was appointed to succeed him as the director. At the same time a contract was signed, binding the University of Texas and the University of Chicago for 30 years in the joint operation of a new observatory, to be built in the Davis Mountains of western Texas from the W. J. McDonald bequest to the University of Texas. The new observatory, equipped with an excellent 82-inch reflector and with up-to-date spectrographic equipment, was completed in 1939. Since then, most of the results in stellar spectroscopy have come from material secured with the McDonald telescope. But it is not possible to distinguish between Yerkes and McDonald contributions. They are closely interwoven and should be regarded as the work of a single group of scientists.

Through the perseverance of many careful observers at the 40-inch telescope there had been gradually accumulated, by about 1925, a fine collection of approximately 10,000 photographs of the spectra of nearly 1,000 different stars. Frost had intended to use this material for the determination of the motions of the stars in the line of sight. The spectra of the stars were flanked on both sides by the spectra of a laboratory source, such as that of the electric spark between iron or titanium terminals. The photographs could then be placed in a measuring machine, and the astronomer could determine the slight "Doppler shifts" of the lines of the star as measured with reference to the lines of the comparison source. This work was carried out in two stages: in 1926 we published the results for 360 stars of the helium type (now designated as class B); in 1929, the velocities of 500 hydrogen-type stars (now designated as class A).

More important was the opportunity which the collection of spectrum photographs offered for the study of the intensities and profiles of the lines. Most people have only a hazy idea of the appearance of the absorption lines in a stellar spectrum. Since the spectrum is produced by illuminating a narrow metal slit with the light of the star, we expect to find a continuous band of colored light, crossed by sharp, black lines whose profiles are faithful images of the slit and whose locations on the continuous spectrum correspond to those shades of color which are absorbed by the atoms in the atmosphere of the star. Such a spectrum is actually observed when we examine the light of the sun with a prism or diffraction grating. But not all stars have such spectra. Many have broad and hazy features in the place of the sharp Fraunhofer lines of the sun, and frequently they are not at all black, even near their centers, but are visible only as very slight depressions of intensity in the continuous spectrum.

In the course of my work on the measurement of the Doppler shifts of these hazy features, I was seriously bothered by the question of whether we could really trust the settings which I was making upon the geometrical centers of the broad lines. The results were plausible, but I would have been better satisfied if I could show that the cause of broadening acted symmetrically toward the red and toward the violet sides of the spectrum. Little was then known about the broadening of spectral lines in the laboratory, and next to nothing about their broadening in the stars.

The first task was to examine all cases of broadened absorption lines in order to determine, if possible, whether they originated from one cause or from several. It was at once clear that very strong lines—those which presumably were produced by large concentrations of atoms—are always broad. Such are, for example, the famous calcium lines of the sun, *H* and *K*. But there are many stars in which all lines, both faint and strong, appear broad. In other stars precisely the same lines are sharp and narrow. This phenomenon was highly intriguing. We tried at first to determine whether the stars with broad lines differed systematically in their other characteristics from those with sharp lines, but in nearly all respects the two groups were identical. We suspected a tendency of the broad-lined stars of the hydrogen type (class A) to be intrinsically less luminous than those with narrow lines, but before our discussion was completed, the same result was announced by Adams and Joy in their paper on the absolute-magnitude difference between stars with nebulous and stars with sharp lines. But the phenomenon did not suggest a physical cause of the line broadening, and it has since been shown to be caused, at least in part, by a systematic difference in the classification of the spectra.

The solution to our problem came from an examination of close spectroscopic double stars. Those with very short periods (of the order of one day) always had broad lines, while those of longer periods usually had much narrower lines. The short-period systems undoubtedly consisted of two stars almost in contact. Tidal forces would compel them to rotate as one solid body: the periods of rotation and revolution would be the same. Hence, the broadening should be due to rapid axial rotation. This result was later confirmed in many different ways, and, by analogy, we concluded that single stars also occasionally rotate with enormous speeds. The highest velocity at the equator is of the order of 300 km./sec.; that of the sun, only 2 km./sec.

The discovery of stellar rotation opened the way to other studies. On the one side, it led to studies of the distribution of rotational velocities and their bearing upon the old problems of the origin of double stars and planetary systems. On the other, it raised the question: Are there other spectroscopic phenomena which are correlated with that of axial rotation? One interesting correlation was found at once: the widths of the hydrogen emission lines observed in a small fraction of the helium and hydrogen stars are correlated with the rotational velocities determined from the absorption lines. The conclusion was simple: these stars are surrounded by nebulous envelopes of luminous hydrogen which revolve around them. When the axis is perpendicular to the line of sight, the emission lines and absorption lines are broad; when it is in the line of sight, both types of lines are narrow. However, the absorption lines can be narrow not only because the axis is in the line of sight but also because the star has actually a slow rotation. Such stars have no emission lines. The existence of the radiating nebula depends upon rapid rotation, it being somehow produced as a result of this—most probably through some kind of equatorial escape of gases from the rapidly rotating star. Sometimes, when we observe a rapidly rotating star whose axis is very nearly perpendicular to the line of sight, a thin, but radially extended, gaseous ring is formed which produces a series of very narrow and sharp absorption lines.

Gradually we eliminated those spectroscopic phenomena which are caused by stellar rotation. After this was done, it appeared that there were many stars of class B in which some helium lines were broad and hazy, while others were sharp and narrow. The lines were all relatively weak; hence, the broadening was not that produced by large concentrations of atoms. An examination of laboratory data on the Stark effect showed that all those lines whose Stark splitting in an electric field is pronounced are broad in the helium stars. This type of broadening is well known to physicists and is ascribed by them to the perturbing action which neighboring charged particles—electrons or ions—produce upon the radiating atoms of helium. Such an effect should be large when the pressure is large, because then the perturbing particles are close to the radiating atoms. Upon this theoretical prediction we built a method for determining the pressure in stellar atmospheres. From these we could easily find the luminosities and could decide from the appearance of the helium lines whether a star is a supergiant or one of more moderate luminosity.

There was an interesting consequence of this work on the Stark effect. In the laboratory the presence of electric fields facilitates the appearance of helium lines which are normally forbidden by the selection rules. These lines were actually found in several dwarf stars such as γ Pegasi and τ Scorpii. But another prediction of the Stark effect could not be verified: electrical fields are known in the laboratory to shift some helium lines toward the red side and others toward the violet side of the spectrum. The broadening should thus be one-sided; the lines should be unsymmetrical and their measured positions should give slightly erroneous wave lengths. We noticed early in our investigations that the broadened helium lines were essentially symmetrical, so that any excess of broadening on one side over that on the other could only be an effect of the second order. Many years ago I suggested that this peculiar discrepancy between observation and the statistical theory of Stark broadening is caused by the collisions of particles and radiating helium atoms. The theory of collisional broadening has in the meantime been developed by physicists. But the exact application to stellar atmospheres was lacking until Chandrasekhar made an important theoretical advance which enabled Mrs. M. Kiess-Krogdahl to explain not only the symmetrical appearance of the lines but also their observed profiles and equivalent widths.

Our next concern was that of the strange, broad but often very deep lines in supergiants and a few peculiar stars such as 48 Librae. Rotationally broadened lines have shallow central depressions; lines broadened by large concentrations of atoms (radiation-damping), by Stark effect, or by collisions, all have characteristic wings. The lines in supergiants have bell-shaped profiles, with relatively steep edges. Thermal motions cannot explain them, because the lines are much too broad for the temperatures known to exist in the reversing layers. Our study was complicated by the fact that the resolving power of astronomical spectrographs is not sufficient to bring out this type of broadening except in very few bright stars. After several years of unsuccessful efforts, Elvey and I finally found the explanation: the atmospheres of many supergiant stars are not quiescent, but show strong, turbulent currents, up and down, so that the observed line-profiles have approximately the shape of a Gauss curve, the motions being distributed more or less in a random manner. There have been numerous investigations of this phenomenon since our announcement of it in 1934. One of the most significant was by J. L. Greenstein, who showed that there exist in the observed profiles appreciable departures from the simple Gauss curve. In a few supergiants (α Cygni) and stars with very extended atmospheres (17 Leporis) there is a tendency for the lines to show profiles with two minima of intensity, sometimes of unequal depth. This would suggest that the motions are predominantly in two streams: one rising in the atmosphere, and the other descending. But the line-profiles show that the two streams must be thought of as consisting of turbulent cells of dimensions which are small, relative to the height of the star's atmosphere. There has as yet been found no direct connection between the phenomena of turbulence in stars and in the earth's atmosphere, but the possibility of such a connection is not excluded.

The most recent advance in this field resulted from a comparison of measurements by Miss H. Steel in the spectrum of δ Canis Majoris with others made by me. The conclusion was that the turbulent velocity is a function of height in the reversing layer, increasing with the latter.

The problem of the central intensities of stellar absorption lines has been the subject of several Yerkes investigations, notably by Greenstein. Stars with large rotations or with other forms of mechanical Doppler broadening, such as expansion in novae or nova-like stars, were, of course, excluded. The hot stars have relatively shallow lines, even in supergiants, but Greenstein pointed out that they are not as shallow as theory would have led him to expect.

In a way, our studies of stellar line-profiles were all preparations for the important task of determining the abundances of the chemical elements in the atmospheres of the stars. There are some reasons to believe that these abundances are not the same in all stars, and much of the evidence comes from the Yerkes and McDonald Observatories. Thus, υ Sagittarii, according to Greenstein, has a low abundance of *H* and a high abundance of *He*, while Popper has found a helium star without any lines of *H* whatever. Astronomers at other observatories have been led to similar conclusions. All of these results depend upon our ability to derive the number of absorbing atoms per cubic centimeter from the profile of an absorption line.

The question of the abundances of the chemical elements in the universe constitutes one of the most fundamental problems of all physical science, and it is receiving increased attention at the Yerkes and McDonald Observatories. It is an extremely difficult problem, however, and astrophysics is full of the graves of premature and insufficiently founded theories and observational conclusions. Among the most convincing data are recent results by G. Herzberg from McDonald spectrograms on differences in abundance of the carbon isotopes in different stars. On the other hand, the writer has recently observed a close binary system (UX Monocerotis) in which the hydrogen absorption lines undergo periodic variations in intensity, so that at times they are almost invisible, while at others they are extremely strong. In this case, at least, it would be unsafe to attribute the variations to changes in abundance. It is certain that the real differences of chemical abundance are still, to a large extent, obscured by an unknown phenomenon which affects the line intensities. It will be necessary to identify this phenomenon and explain it before we can succeed with the abundance problem.

After we had derived a reasonably complete understanding of the profiles of stellar absorption lines, it was tempting to apply the new knowledge to certain mysterious stars which had puzzled astronomers since the days of Huggins. Foremost among them was the problem of ϵ Aurigae. A spectroscopic double star with a period of 27 years, this third-magnitude star shows only the lines of one component, and it is from the variable Doppler shift of these lines that the orbit could be determined. The plane of the orbit is in the line of sight, and once every 27 years the principal component of ϵ Aurigae is eclipsed by the other, invisible component. Spectroscopic double stars are not rare: several hundred have been discovered and critically analyzed. But ϵ Aurigae presented a puzzle which would not yield to the conventional methods of analysis. The eclipse was found to be total, so that the disk of the dark, invisible component completely covered that of the bright, visible star. Yet the spectral lines of the latter remained visible throughout the many months of totality. Most of them were greatly strengthened, appearing unsymmetrical during the partial phases of the eclipse. The light curve is of such a character, however, that the invisible, dark component can only be of much lower surface temperature than the principal component and consequently should have other absorption lines, namely, those which are characteristic of low temperature. Observations of ϵ Aurigae were started by Frost almost as soon as the Yerkes Observatory was opened. Several investigations of its spectrum were made at different times by Frost, Struve, and Elvey, but, while much valuable information was obtained, the cardinal question of why the lines of the bright component remained visible during totality remained unanswered. Finally, in 1937, armed with our new knowledge of line formation and with a new theory of the light curve, the problem was solved in a joint investigation by Kuiper, Struve, and B. Strömgren. The invisible, eclipsing star is incredibly large, its diameter being roughly similar to that of the orbit of Saturn. This enormous, cool supergiant is partly transparent, so that the light of the much smaller, bright component of the system shines through it. The asymmetries of the lines are produced by the gases of the cool supergiant, whose axial rotation produces a small relative displacement.

There remained one small but rather puzzling circumstance. The absorption effects in the cool supergiant which give rise to the observed asymmetries of the lines did not influence the strong magnesium line, Mg II 4481. This was unexpected, because from analogy with other, ordinary stellar spectra we should have believed this line to be affected quite as much as the numerous lines of Ti II, Fe II, etc. We started looking for other astronomical spectra which might show a similar weakness of the Mg II line. The outcome was a series of investigations, in which K. Wurm cooperated, on the suppression of lines with excited lower levels which are not metastable, when the field of radiation is of small density, but corresponds in distribution with wave length to a high temperature. The fundamental theoretical idea of this work goes back to a paper by S. Rosseland, published in 1926, and the phenomenon is usually described as that of diluted stellar radiation.

This phenomenon has proved to be a remarkably powerful tool in astrophysics. A layer of gas in front of a radiating stellar photosphere is, in effect, an absorbing screen which reduces the intensity of the transmitted beam in those wave lengths to which the atoms of the screen are tuned. An ordinary absorbing screen absorbs a fixed fraction of the incident light, whether it is placed close to the radiating source or close to the eye of the observer. But the absorbing source of magnesium atoms has the property of absorbing a larger fraction of the incident light if the atoms are near the surface of the star and a smaller fraction if they are far above the surface of the star. The suppression of the magnesium lines in ϵ Aurigae during the total eclipse means that the atoms are very far away from the source of light—the small, bright component which is being eclipsed. This is exactly what we had already deduced from the unsymmetrical lines of titanium, iron, etc. The latter are not sensitive to the dilution effect and always absorb the same fraction of the incident light, no matter what their distance is from the radiating source. If all absorbing atoms—those of magnesium, as well as those of titanium, iron, etc.—are located in the semitransparent, invisible supergiant component, we should be able to determine the distance between the two components from the degree of suppression of the magnesium lines.

The most interesting applications of the theory of the dilution effect have been obtained in the case of the lines of helium. Some have lower levels which are metastable, while other, equally strong lines have excited lower levels which are not metastable but are connected with the ground level of the helium atom by very strong ultraviolet transitions. The former are not affected by the distance of the source, while the latter are suppressed unless the atoms are on the surface of the star itself.

We at once made use of this discovery. In several stars we found the sensitive helium lines to be suppressed by a factor of the order of 100, as compared to the normal intensities of these lines. Since the degree of suppression is proportional to the amount of radiant energy from the light source at the point where the helium atom is located, and since this is inversely proportional to the square of the distance from the star, we were able to conclude that the absorbing screen of helium atoms is located at an average distance of roughly 10 times the radius of the star itself.

This immediately led to the solution of another astronomical puzzle, namely, that of the famous eclipsing binary, β Lyrae. By a strange coincidence, the problem of β Lyrae was discussed at a conference of astronomers in connection with the dedication of the Yerkes Observatory in 1897, but the final solution came in a joint study by Kuiper and Struve in 1941. The system of two giant stars with almost touching surfaces generates a gaseous stream which flows from one component toward the other and is then split into two branches: the one flows around the cooler of the two components and returns ultimately to the place of origin; the other is forced by centrifugal action to leave the system and spirals rapidly outward into space. Gaseous streams produce remarkable absorption effects when observed in front of the luminous body of the hotter component of β Lyrae. When apparently projected upon empty space, they produce strong emission lines in the spectrum.

The recognition of gaseous streams in β Lyrae soon led to the discovery that many other binary systems possess similar streams. During the past four years much effort has been spent at McDonald and at Yerkes, at first in the study of the emission features produced by these streams, and more recently in the study of the corresponding absorption effects. This work is still in progress. A particularly interesting feature of these double-star spectra is the shape of the emission lines of hydrogen, consisting of two separate peaks. As the invisible component of the double star begins to eclipse the brighter component, we observe at first the disappearance of the violet emission peak; then, during total eclipse we often fail to see any trace of emission, while after totality we observe the appearance of the violet peak and the disappearance of the red peak. The emitting atoms of hydrogen form a ring around the bright double-star component which revolves around the latter in the same direction as the orbital revolution.

In 1939, P. Swings came to the Observatory from Belgium to collaborate in the study of another class of peculiar stellar spectra. He intended to remain for one year, but the war intervened and he remained until the middle of 1943. During this interval we devoted most of our attention to an interesting group of objects—those whose spectra have sharp and narrow emission lines of highly-ionized atoms, often including the forbidden nebular types of radiation. Due to Swings' experience in the spectroscopic analysis of laboratory sources we were able to record and identify numerous previously unknown emission lines. Many new results were obtained, and the previously proposed hypothesis of the binary nature of these objects was greatly strengthened.

Another puzzling group of objects was attacked by Swings and Struve with the large coudé spectrograph in a study of α Canum Venaticorum. This star has at times very strong lines of Eu II, Gd II, and other rare earths, but the intensities are variable in a period of about 5 days, so that at certain other times the rare earths are absent or very weak. An exhaustive investigation gave a good description of the phenomena, but served only to eliminate such simple explanations as a periodic change in normal ionization conditions. We found a few suggestive relations, but were unable to account for the extraordinary variations. We next observed another star having variable lines, ϵ Ursae Majoris, but again there was no physical explanation. W. A. Hiltner made a study of β Coronae Borealis in which the rare-earth lines are also unusually strong but in which there are no periodic variations in intensity; no clue to our problem was found. We have a large amount of observational facts for a few stars, and it is disconcerting that no theory is able to account for them. For further progress, more stars with variable lines must be found. This work of discovery was at first undertaken by W. W. Morgan, who in the early 1930's found several new representatives of this almost completely neglected class. A. J. Deutsch has greatly extended the work of discovery and has furnished us with a list of interesting objects and their periods. Whether we now have a broad enough basis of observational data to insure success in our search for a physical theory remains to be seen.

During the past 15 years the 40-inch telescope has been used to good advantage for spectroscopic investigations with instruments of small dispersion. An *Atlas of stellar spectra* by Morgan, Keenan, and Kellman has become the accepted standard for the classification of stars according to their temperatures and pressures. Another atlas consisting of spectrophotometric tracings of coudé plates of 8 bright stars taken at the McDonald Observatory with dispersions between 2 and 14 A./mm. was prepared by Hiltner and Williams and published by the University of Michigan Press. This serves as a valuable source for many astrophysical investigations.

Among the fuzzy-line stellar spectra of the helium type there were many which had sharp and exceedingly narrow lines of ionized calcium. These lines were known to Frost and his co-workers and aroused their interest because all other lines, such as those of He I, Si III, O II, etc., were uniformly broad and hazy. The problem of the sharp calcium lines was brought to a focus when in 1904 J. Hartmann, of Potsdam, announced that these lines remained stationary in the spectroscopic binary δ Orionis, whose other absorption lines showed the characteristic periodic variation in radial velocity as the binary pursued its course along an orbit whose plane is approximately in the line of sight. Hartmann had suggested that the stationary calcium lines are produced by a cloud of calcium atoms in interstellar space and have no relation to the binary system. But this revolutionary hypothesis was not accepted by other astronomers, and several investigations appeared (erroneously, as we now know) to show that the calcium atoms are distributed in the immediate neighborhood of the double-star components. The problem remained in this state until 1926, when A. S. Eddington, in his famous Bakerian Lecture of that year, presented strong theoretical arguments in favor of the existence of an exceedingly tenuous gaseous substratum in interstellar space. Eddington's work led to a simple prediction: the sharp calcium lines must be present in all distant stars, not only in spectroscopic binaries, and their absorption intensities must increase with the distances of the stars. The rich spectrographic material of the helium stars at the Yerkes Observatory offered a tempting invitation to test Eddington's hypothesis. We already knew that the helium stars have exceedingly high intrinsic luminosities—100 or even 1,000 times the candle power of the sun—so that for any given apparent magnitude an average helium star is from 10 to 30 times as far away as one of the solar type.

A preliminary study of the Yerkes collection gave a strong indication that the sharp calcium lines were indeed stronger in the more distant stars, but because of the limited light-gathering power of the Yerkes telescope the range in distance was not sufficiently large to place the result beyond all reasonable doubt. Our telescope was not big enough to photograph the spectra of the fainter and, hence, the more distant stars. In order to supplement the Yerkes material I obtained permission from W. S. Adams to spend several months at the Mount Wilson Observatory and to use the 60-inch reflecting telescope for the observation of the spectra of a selected list of faint helium stars, principally in the constellations Cepheus and Cygnus. I was also permitted to inspect the magnificent collections of stellar spectra at Victoria and at the Lick Observatory. The final result was a complete confirmation of Eddington's hypothesis: interstellar space contains a gaseous medium in which the ionized atoms of calcium—those which produce the observable lines *H* and *K* in the violet part of the spectrum—are distributed with a density so low that approximately one calcium ion is found in every 10^8 cc. of space. An interesting by-product of this work was a new method for the determination of the distances of the more remote stars in our galaxy from the measured intensities of the interstellar absorption lines.

In the meantime, principally through the research of H. N. Russell at Princeton, it had become amply clear that hydrogen forms by far the most abundant substance in the stars and nebulae. It seemed strange that the gaseous substratum in interstellar space should consist mostly of calcium. Was it not possible that, because of the very unusual conditions of extremely low pressure, high exciting temperature, and excessively low density of the exciting stellar radiation, the calcium lines would be placed at an advantage in producing absorption lines, while the hydrogen lines, even though produced by an exceedingly abundant species of atoms, would absorb so weakly that its lines would escape detection? There were theoretical reasons to suspect this; but how could we prove it? A simple computation showed that the interstellar hydrogen atoms, if really present in anything like the expected abundance, might produce a faint glow of radiation in the Milky Way, between the stars. There was, however, no spectrograph at our disposal sufficiently powerful to record this feeble hydrogen radiation.

We had a new Schmidt camera of the then unusual focal ratio f/1, which had been made for us by a Chicago amateur telescope maker, as well as a pair of excellent quartz prisms, but there was no suitable collimator. We decided to build a strange, new instrument at the McDonald Observatory. This has since been described in the astrophysical literature as a "nebular spectrograph." A small, clock-driven, equatorial mounting supports on one side a long, narrow, rectangular, plane piece of mirror which serves as the slit, and on the other side the Schmidt camera with quartz prisms, working as an objective-prism instrument. The reflection from the slit-mirror is directed upward along the polar axis to a stationary plane mirror placed higher up on the slope of our mountain. This circular mirror reflects the beam toward the camera, which is focused on the slit mirror at an effective distance of 150 feet. This instrument gave excellent results, and in a short time Elvey and I could announce the existence of vast regions of hydrogen radiation in the Milky Way. The average density of the interstellar hydrogen is about 1 atom/cc.

After the completion of the 82-inch telescope at McDonald in 1939, the nebular spectrograph was dismounted, and the work on interstellar hydrogen radiation was discontinued. In recent years J. L. Greenstein has used the large reflector in a study of the physical properties of those condensations of the interstellar medium which we know as gaseous nebulae.

Solar Research and Theoretical Astrophysics

S. Chandrasekhar

THE GREAT DISCOVERIES ASSOCIATED with the name of Hale—the spectroheliograph, the double reversal of the H and K lines of calcium in the spectrum of the flocculi, the magnetic field of sun spots and their laws of polarity, the general magnetic field of the sun—all belong to the earlier Kenwood period or the later Mount Wilson period. Hale's years at the Yerkes Observatory appear at this distance of time as an interim period of consolidation and study between years of great imagination and discovery. This may be disappointing to one who is looking back at the record of the Yerkes Observatory. Nevertheless, there is one romantic incident to which the University of Chicago (and the Yerkes Observatory) may lay lawful claim, namely, when Hale met the challenge of the spectroscopist, Carl Runge, that the bright yellow line discovered by the chemist, Sir William Ramsay, in the discharge through the gas occluded by the uranium mineral clevite cannot be identified with helium "unless the solar D_3 line were also double." On June 20, 1895, Hale succeeded in resolving the D_3 line of a bright solar prominence "into a delicate unequal pair" and "our possession of helium as a truly indigenous element was rendered incontrovertible."

Though the solar research carried out at Yerkes Observatory must take second place to the brilliance of the discoveries to be made only two or three years later at the Mount Wilson Observatory, the record of the Yerkes Observatory during the years between Kenwood and Mount Wilson is not insignificant. Indeed, Dr. Adams has written:

> As Hale moved onward to the wider field of work afforded by the Yerkes Observatory, he saw opportunities for extending his investigations with more powerful apparatus. A large spectroheliograph was one of the first requisites, and the Rumford spectroheliograph, when attached to the 40-inch refractor, has remained one of the most efficient instruments for certain types of solar research ever designed. With it dark hydrogen flocculi were discovered and the dark calcium markings which proved to be prominences seen in projection against the disk. The dispersion of the instrument was sufficient to make it possible to set the second slit upon different portions of the K line, and thus map the calcium flocculi at different levels through the solar atmosphere. A grating spectrograph supplemented the spectroheliograph, and with it Hale made the difficult visual discovery of the presence of the green carbon band in the spectrum of the chromosphere. He became fully aware at this time of the possibility of observing the chromospheric and much of the "flash" spectrum without an eclipse and in future years continued such work at Mount Wilson.
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> A strangely prophetic remark was made by Hale in an article published at the Yerkes Observatory in 1902: "The remarkable peculiarities of the spectra of sun spots seem to deserve more attention than they have hitherto received from spectroscopists." Widened lines in the spectra of spots had been observed visually by Young in 1872 and were studied systematically by the English astronomers Maunder, Cortie, and Lockyer. Hale made some attempts to photograph the spectrum of sun spots while at Kenwood Observatory, but his success was only partial because of the small size of the sun's image. With the larger image given by the 40-inch telescope at the Yerkes Observatory much better results were obtained, and not only were the widened lines measured but also many of the lines in a green band discovered by Maunder in 1880. Hale realized that for an adequate investigation of the spot spectrum greater linear scale in the spectrograph and a still larger image were needed. Accordingly he designed for the purpose a large spectrograph used in conjunction with a coelostat and long-focus concave mirror, thus planning to bring into regular astronomical use an instrument which had been relegated almost wholly to eclipse expeditions. This instrument finally took form in the Snow telescope with which in later years at Mount Wilson the first of the extensive sunspot investigations was begun.

After Hale's departure from the Yerkes Observatory, the Rumford spectroheliograph continued to be used systematically for many years. Of these later studies the most important are those of the late Philip Fox on "The Rotation Period of the Sun" and of Edison Pettit on "The Forms and Motions of Prominences." In the first of these two investigations Fox derived from some 4,000 measures of calcium flocculi on 285 plates the law of variation of the diurnal motion (ξ) in mean solar days at various heliographic latitudes (ϕ). He found that $\xi = 11^\circ.584 + 2^\circ.976 \cos^2\phi$. This law differs from those derived spectroscopically by Adams and presents a problem still awaiting solution.

In his investigations on the forms and motions of the solar prominences Pettit broke new ground, and his first study of the subject at the Yerkes Observatory still remains a classic. From this early study the remarkable fact already had emerged that the motion of a prominence measured along its trajectory is uniform, increasing suddenly at intervals as if by an impulse. This fact, confirmed by numerous later observations, still defies a satisfactory explanation.

After 1920 conventional solar research began to lag behind in the wake of the expanding interests in stellar astronomy and astrophysics, but occasionally some important investigations were carried out—for example, P. C. Keenan's careful photometry of the solar granulation. In one sense, however, interest in solar problems was never really lost. Indeed, as Hale has so often emphasized, "the student who would untangle the secrets of the universe recognizes in the sun a typical star." This is particularly true of the student of theoretical astrophysics: for, a theory of stellar constitution, to be satisfactory, must first account for the solar energy, and a theory of stellar atmospheres, to be satisfactory, must first account for the solar spectrum. Thus, a problem which has been studied intensively during recent years relates to the continuous spectrum of the sun.

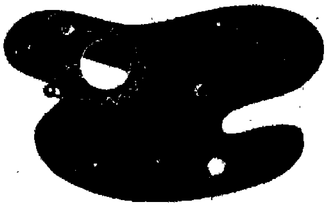
It has long been known that the observed laws of darkening and the distribution with wave length in the continuous spectrum of the sun imply a source of continuous absorption in the solar atmosphere which varies with wave length in the following manner: The absorption coefficient increases by a factor of the order of two from 4,000 to 9,000 A.; beyond 9,000 A. it decreases by about the same amount until we reach 16,000 A. in the infrared; and the indications are that as we go further into the infrared, the absorption coefficient again increases. For many years one of the principal problems of astrophysics was to determine the source of continuous absorption in the solar atmosphere which will show the behavior we have described. On the basis of theoretical work done at the Yerkes Observatory it has now been established beyond any possible doubt that the negative ions of hydrogen are responsible for the continuous absorption in the solar atmosphere from 4,000 to 20,000 A. This identification of the presence of the negative ion of hydrogen recalls to one the case of helium, whose presence in the solar atmosphere was known a quarter of a century before its terrestrial existence was established. In the case of the negative ion of hydrogen, its stable existence was first established by Bethe and Hylleraas on theoretical grounds, and it was only 15 years later that its physical existence as a free atom was established in the solar atmosphere.

The brief reference to the continuous spectrum of the sun which we have made reminds us of the important role which problems of radiative transfer have played in the theory of stellar atmospheres. Until recently the solutions even for the simplest problems were not available. But the studies undertaken at Yerkes Observatory during the past few years have provided *exact* solutions for a great variety of problems. From one point of view the most important of these advances relates to the solution of transfer problems in which the polarization characteristics of the radiation field are properly taken into account. The importance of such considerations has been recognized since 1871, when Lord Rayleigh accounted in a general way for the distribution and polarization of the sunlit sky. Nevertheless, even the basic equations for the problem were not written down before the problem arose in an astrophysical context. We may briefly explain the particular astrophysical problem which gave the final impetus to formulating and solving transfer problems in which the polarization characteristics of the radiation field are incorporated and properly allowed for.

From the investigations of J. L. Greenstein and others it appears that in the atmospheres of stars with surface temperatures exceeding 20,000° K the transfer of radiation must be controlled predominantly by the scattering by free electrons. According to J. J. Thomson's laws for this process, scattering by free electrons must result in the partial polarization of the scattered radiation. If our belief in the important role played by the Thomson scattering in the atmospheres of the hot stars is correct, we should expect that the radiation emergent from the atmospheres of such stars should be partially polarized. The question of the degree of polarization to be expected under such conditions therefore becomes a matter of exceptional astrophysical interest. But before we can answer this question, the relevant equations of transfer distinguishing the different states of polarization must be formulated and solved.

The problem of radiative transfer in an electron-scattering atmosphere has now been solved exactly, and the theory predicts a degree of polarization to the extent of 12 per cent at the limb. It is apparent that if the predicted effect is present, the most favorable conditions under which the phenomenon could be observed are during phases close to the primary minimum in an eclipsing binary, one component of which is an early-type star. It is gratifying to be able to record that careful polarization measurements on RY Persei by A. W. Hiltner at the 40-inch telescope indicate that the effect of the predicted amount is very probably present.

The foregoing brief sketch is intended merely to give an impression of the kind of problems in solar and theoretical astrophysics which have been studied at the Yerkes Observatory. But it serves to underline a fact which Hale often emphasized, namely, that there is "no essential difference between the attitudes of a physicist and an astronomer."



The Spectroscopic Laboratory

G. Herzberg

IN AN ADDRESS TO THE ROYAL INSTITUtion in May 1909, George E. Hale spoke as follows:

> It is customary to distinguish sharply between observational and experimental sciences, including astronomy in the former. In physics or chemistry the investigator has the immense advantage of being able to control the conditions under which his observations are made. The astronomer, on the other hand, must be content to observe the phenomena presented to him by the heavenly bodies and interpret them as best he may. I wish to emphasize the fact, however, that the distinction between these two methods of research is not so fundamental as it may at first sight appear. In 1860 a laboratory in which experiments were conducted for the interpretation of astronomical observations was established by Sir William Huggins on Upper Tulse Hill. The advantage of imitating celestial phenomena under laboratory conditions was thus appreciated half a century ago. I shall indicate later how important a part such a laboratory plays in the work of the Mount Wilson Solar Observatory. I shall also show that in other ways the astronomer may advantageously follow the physicist, particularly in the choice of observational methods and in the design of instruments of research.

Hale realized, perhaps more clearly than anyone else of his time, the importance of laboratory investigations for the interpretation of celestial spectra and other astrophysical problems. Therefore, he had provided considerable space for laboratory work in his plans for Yerkes Observatory. There was a spectroscopic laboratory, a chemical laboratory, a physical laboratory, a galvanometer room, a concave grating room, and other laboratory rooms, making up fully 25 per cent of all the space, other than the domes, available at that time. In the heliostat room Hale made provision for drying the air to make possible the use of rock salt prisms and lenses, obviously having in mind plans for investigating the infrared solar spectrum, and he emphasizes that "the entire distance (175 ft.) between the heliostat room and the wall of the great tower is available for use with apparatus containing mirrors or lenses of great focal length, etc."

Needless to say, Hale made full and frequent use of these laboratory facilities. Mention should perhaps be made of his extensive research in collaboration with N. A. Kent on "The Spectrum of the High Potential Discharge Between Metallic Electrodes in Liquids and in Gases at High Pressures" (*Publ. Yerkes Observ.*, 1907, III, 29), which led to abandonment of the pressure theory of novae advanced by Wilsing and which at the same time represented one of the first systematic investigations of the effects of pressure and other discharge conditions on the spectrum produced.

With Hale's departure from Yerkes Observatory, interest in laboratory investigations gradually subsided, and with the increase in staff the various laboratory rooms were gradually assigned to offices and other purposes. This development was compensated in a way by the growing interest of physicists at the beginning of this century in laboratory spectroscopy and by the rapid developments in the interpretation of spectra with the aid of quantum theory. Great strides were made in the advancement of our knowledge of the line spectra of individual elements and of the band spectra of many molecules. The profound influence of these developments on astrophysics hardly needs special emphasis.

Toward the end of the fourth decade of this century, when many of the fundamental problems of atomic and molecular spectroscopy had been solved, the interest of the physicist in spectroscopy lessened, and his attention turned more and more to nuclear physics. At present, very few physics departments are left in this country in which research in spectroscopy of the type of interest to the astronomers is actively prosecuted. On the other hand, while some problems, such as the identification of the nebular lines and the coronal lines, have been solved, others have remained unsolved, and new ones constantly appear which might be solved by cooperation of the astrophysicist and laboratory spectroscopist. This is particularly true in the field of molecular spectra, whose application to astrophysical problems has proved fruitful in recent years. It was with these points in mind that the administration of Yerkes Observatory asked the writer two years ago to join the staff and re-establish a spectroscopic laboratory.

Since the rooms originally assigned by Hale for laboratory work were no longer available, the new laboratory was set up in the basement between the two small domes. A 21-foot grating in a modified Eagle mounting was installed. The location of this instrument was so chosen that, with the aid of a heliostat and one additional mirror, the solar spectrum can be studied and a comparison with laboratory spectra thus easily made. The grating, supplied by R. W. Wood, has an excellent concentration in the first order of 11,000 A. or second order of 5,500 A., etc. In addition, a medium Hilger quartz spectrograph was purchased for work with intermediate dispersion. More recently, the photoelectric infrared spectrometer built by Dr. Kuiper for work at McDonald Observatory has also been used in the laboratory.

A considerable part of the activity of the laboratory at present is devoted to the investigation of molecular gases with long absorbing paths, particularly for comparison with the spectra of planets. As is well known, the spectrum of Venus in the red and near infrared shows absorption bands of carbon dioxide (CO_2), while the spectra of Jupiter, Saturn, Uranus, and Neptune show strong bands of methane (CH_4), and Jupiter, in addition, shows ammonia (NH_3). In the laboratory these absorption bands can be obtained only with very long absorbing paths, indicating that large quantities of the respective gases are present in the planetary atmospheres. In all previous laboratory work (with the exception of NH_3), in order to duplicate the planetary spectra, very high pressures had to be used. These broaden the lines to such an extent that much or all of the fine structure of the bands is lost. For a more detailed comparison it appears necessary to use much longer paths than heretofore, so that the planetary spectra can be reproduced at comparable pressures. Indeed, it should be possible in this way to obtain not only the total amounts of these gases present above the reflecting layers of the planets but also at least rough estimates of pressures and temperatures.

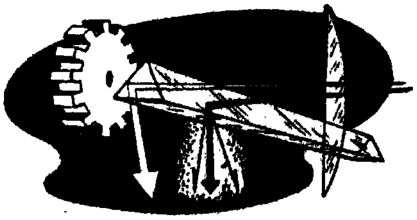
For these investigations a long iron pipe, 10 inches in diameter and 75 feet long, was installed running through almost the whole length of the basement. By means of mirrors according to a scheme devised by J. U. White (*J. opt. Soc.*, 1942, **32**, 285), light of a continuous spectrum was made to traverse this pipe up to 100 times before entering the spectrograph. Thus, an absorbing path of up to 7,500 feet, or 2,200 m., has been obtained. In this way it has been possible to reproduce at atmospheric pressure, and even at lower pressures, the CO_2 bands observed in Venus, with their fine structure preserved. The laboratory intensity is still appreciably less than that observed in Venus, indicating an amount of CO_2 in Venus of more than 1,100 m. atm. At the same time it is possible to say that the pressure in the Venus atmosphere (above the reflecting layer) is less than 1 atm. and that the temperature is near room temperature. These preliminary results will have to be checked and extended, particularly to include CH_4. Moreover, the spectral region 1-2.5 μ will be investigated jointly with Dr. Kuiper with the aid of his infrared spectrometer and for the purpose of comparison with the planetary spectra which he has obtained in this region with the same instrument.

The same long optical path is also being used for the study of the ultraviolet absorption of atmospheric and other gases. A number of years ago an extremely weak system of absorption bands of oxygen with adjoining continuum was found in the near ultraviolet (from 2,600 A. to shorter wave lengths). This band system has now been obtained with adequate intensity of absorption and under high resolution, so that a fine structure analysis will be possible. Absorption in the adjoining continuum leads to dissociation of O_2 into O + O. It is probable that this process is responsible for the formation of the ozone layer. In addition, it may be noted that it is this absorption that accounts for the fact that the solar spectrum does not reappear between 2,200 and 2,000 A., where the ozone absorption is negligible. Finally, it is likely that the same band system accounts for a number of prominent and otherwise unidentified features of the spectrum of the night sky (P. Swings. *Ap. J.*, 1943, **97**, 72).

Another field in which work has been taken up in the laboratory is the study of molecular spectra occurring in late-type stars. A system of green bands first found in certain N stars by Sanford is as yet unidentified (see A. McKellar. *Roy. astr. Soc. Canada*, 1947, **41**, 147). A considerable amount of work was done by J. Phillips to duplicate this spectrum in the laboratory, as yet without success. Prominent features of all M stars are the bands of TiO, while in S stars the bands of ZrO predominate. Some laboratory work on these molecules has been done in the past, but much more work remains to be done, particularly if one wants to obtain reliable values of the dissociation energies of these molecules.

Reliable values of dissociation energies are lacking also for a number of other astrophysically important molecules, notably carbon monoxide (CO). Work is in progress in the laboratory by K. N. Rao for the purpose of obtaining an unambiguous determination of the heat of dissociation of CO.

For a theoretical discussion of the dissociation equilibrium in stellar atmospheres a knowledge of the dissociation energies of all molecules likely to be formed is necessary. A number of dissociation energies used in earlier work in this field are now known to be grossly in error. Once their exact values have been established, a rediscussion of this field might be in order.



The Yerkes Observatory: Past, Present, and Future

Otto Struve

THE YERKES OBSERVATORY WAS planned and organized by George E. Hale who, at the age of 24, had been appointed professor of astronomy at the new and struggling University of Chicago. Through the generosity of Charles T. Yerkes, traction magnate of Chicago, two 40-inch glass disks were purchased from the firm of Mantois in Paris, and a contract was signed with Alvan G. Clark, of Cambridgeport, Massachusetts, for the work of grinding and polishing. The mounting for the large telescope was made by the Warner and Swasey Company, Cleveland, Ohio, and was exhibited at the Columbian Exposition in Chicago in 1893. The building of the Observatory, on the north shore of Lake Geneva, in Williams Bay, Wisconsin, was started in 1895. On May 19, 1897, the objective for the large telescope arrived in Williams Bay. Two days later, after it had been mounted in the 62-foot tube, astronomical observations were commenced by G. E. Hale, E. E. Barnard, and S. W. Burnham. The quality of the star images was found to be exceedingly fine, and the great light-gathering power of the lens was so remarkable that Barnard remarked that he had never before seen so clearly the faint stars of the cluster in Hercules.

The Observatory was dedicated on October 21, 1897, in the presence of a large gathering of astronomers and guests. Henry Crew, of Northwestern University, one of

Group photographed at the dedication of the Yerkes Observatory, October 20, 1897: E. E. Barnard, C. H. Rockwell, George F. Hull, —— Colton (?), Kurt Laves, Frank W. Very, E. B. Frost, Henry M. Paul, Ernest F. Nichols, F. R. Moulton, Ephraim Miller, Father John Hedrick, John M. Van Vleck, Milton Updegraff, Wm. R. Brooks, F. L. O. Wadsworth, H. C. Lord, F. H. Seares, George W. Hough, W. H. Collins, Caroline E. Furness, Mrs. Pickering, Mrs. Hale, Miss Cunningham, Alva A. Lyon, Carl A. R. Lundin, J. A. Parkhurst, J. A. Brashear, G. W. Ritchey, C. H. McLeod, Father J. G. Hagen, Charles L. Poor, J. K. Rees, Mary W. Whitney, F. P. Leavenworth, Henry S. Pritchett, J. E. Keeler, A. G. Stillhamer, Hugh L. Callendar, George W. Myers, C. L. Doolittle, E. C. Pickering, A. W. Quimby, Asaph Hall, Albert S. Flint, M. B. Snyder, W. W. Payne, Carl Runge, Winslow Upton, George Kathan, G. D. Swezey, George E. Hale, N. E. Bennett, George C. Mors, F. Ellerman, W. J. Humphreys, and Henry Crew.

the few surviving scientists who attended this celebration, has written as follows in a personal letter to the author:

> Hale's sound judgment and capacity for friendship were clearly shown by the first staff which he assembled at Williams Bay and by the group of productive scholars who "assisted" at the dedication of the Observatory. In the picture of this group, taken at the south entrance, one sees E. C. Pickering—long-time friend and adviser—standing in the front row between Keeler and Runge [right, extreme front]; and this in turn reminds one of that interesting remark which Runge made on that same day, in the meeting, when W. J. Humphreys had finished reading his report on the effect of pressure in displacing the lines of the arc-spectrum. Rising in his place, Runge said, "Mr. President, Nature is getting more and more disorderly every day!" and then proceeded to accept Humphreys' surprising results at full value.
>
> Returning to the group picture, the man in the front row with the white beard and with his hands in his pockets is that keen and doughty observer, G. W. Hough. At the extreme left, stands E. E. Barnard, at that time, the greatest of all living observers; while at the extreme rear of the picture, standing against one of the columns, wearing a cap and black beard, is F. L. D. Wadsworth—physicist, engineer, and astronomer—a man who helped Michelson and Hale more than the world will ever know.

Since the summer of 1897 the 40-inch telescope has been used regularly on all clear nights for the observation of stars, comets, and nebulae, and on many clear days for the observation of the sun. In 1897 it was the largest telescope of any kind then in actual operation, although Lord Rosse, and others, had already constructed and temporarily used reflecting telescopes of greater aperture. After 50 years the 40-inch telescope is still the largest *refractor* in the world. An attempt in France, many years ago, to construct an astronomical objective of more than 50 inches in diameter ended in failure. World War I interfered with the completion of a 41-inch refractor for an observatory in southern Russia, and the project was abandoned.

In certain types of astronomical observations the 40-inch refractor of the Yerkes Observatory still ranks at the top of the long list of telescopes. It is very little affected by changes in temperature, and it is never necessary to disturb it in its cell. In the most precise measurements of relative star positions it is often necessary to compare results obtained on different photographs taken many years apart. Such photographs would be rendered almost useless if the adjustments of the image-forming lens or mirror were changed between exposures. For example, a very slight change in the collimation of the objective can result in a small change of the character of the star's image of a point-source, like a star. This, in turn, would produce a spurious change in the distance between two stars of unequal brightness. Astronomers measure on their photographs displacements of less than 0.001 mm., corresponding to an angular distance of 0.01 second of arc in the focus of the 40-inch objective. Only the lenses of refracting telescopes have the required degree of stability and permanence. The large astronomical mirrors, many of which surpass the 40-inch objective in aperture, are subject to distortions causing astigmatism and to changes in adjustment when they are removed for silvering or aluminizing.

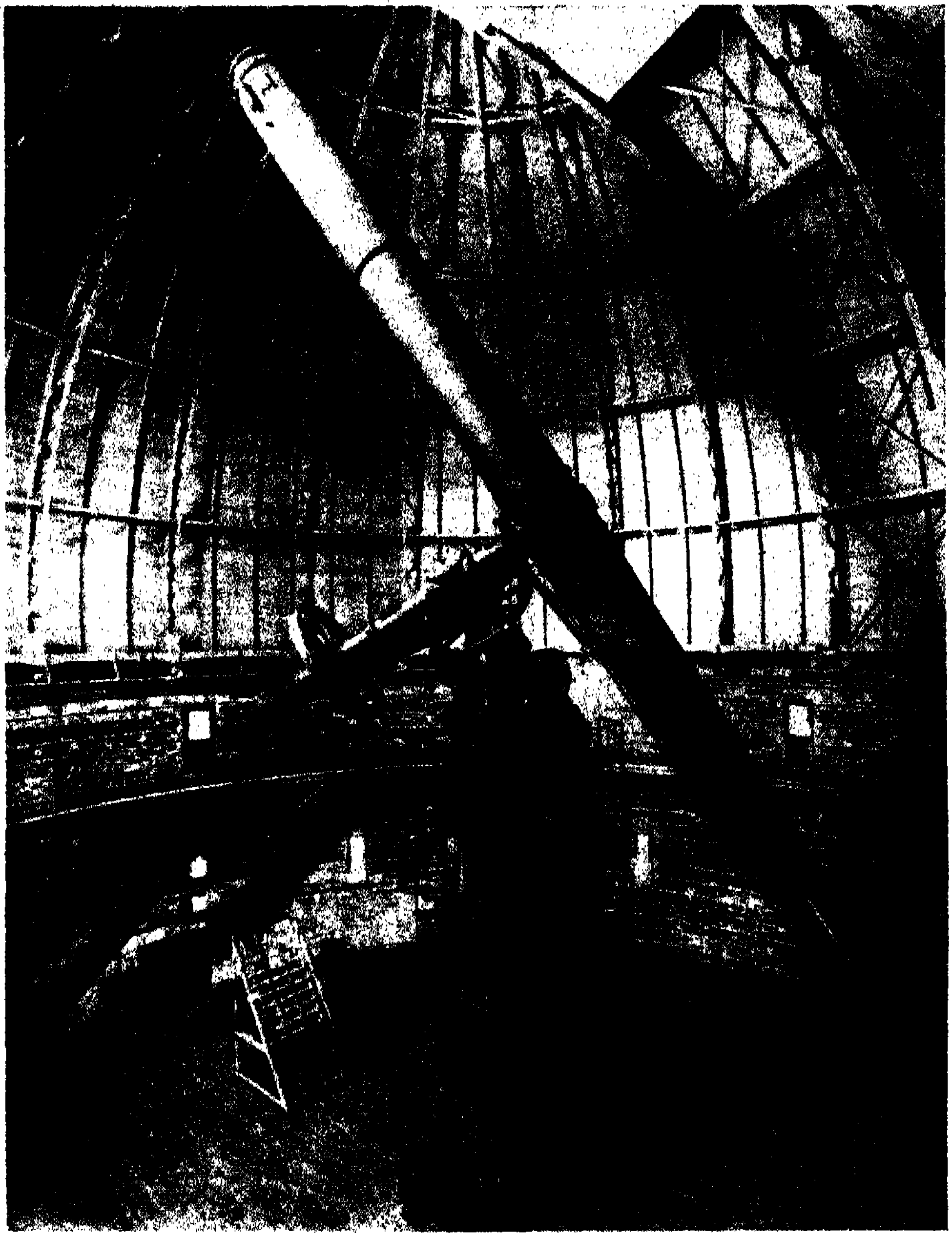
The principal advantage of the 40-inch telescope over all others in existence is in the determination of stellar distances and angular stellar motions. It can also compete with other instruments in the visual and photographic measurement of double stars. But it is surpassed by the large reflectors in most other types of observational work.

Hale intended, from the very beginning, to construct for the Yerkes Observatory a large reflector. His father donated a 60-inch glass disk, and G. W. Ritchey undertook the work of grinding and polishing in the optical shop of the Observatory. The gift of the mirror was conditional upon the University supplying the necessary funds for the mounting and dome. Unfortunately, the University was unable to meet these requirements, and when Hale left the Yerkes Observatory in 1904, he arranged for the transfer of the 60-inch reflector to the Mount Wilson Observatory. With him also went the large horizontal Snow telescope for solar research, as well as several members of the Yerkes staff, including Adams, Pease, Ellerman, and Ritchey.

Before his departure Ritchey completed for the Yerkes Observatory a smaller reflector—one with a 24-inch aperture. This instrument has been used to good advantage for photometric studies of stellar brightnesses by J. A. Parkhurst, for the photography of nebulae, clusters, and other interesting objects by Ritchey, and for the determination of the spherical coordinates of comets and minor planets by Van Biesbroeck.

Soon after Hale's departure for Pasadena, Edwin B. Frost was appointed director. The staff then consisted of S. W. Burnham and E. E. Barnard as senior astronomers, P. Fox as solar physicist, F. Schlesinger as holder of a Carnegie Institution grant for the measurement of stellar distances, J. A. Parkhurst as photometric observer, and S. B. Barrett as secretary and librarian. The principal observing programs during the next 25 years consisted of photography of the sun with Hale's spectroheliograph; determination of stellar distances from photographs with the 40-inch; visual measurements of double stars with the micrometer; determination of positions of comets and other moving objects in the solar system; discovery and measurement of stars of large proper motions across the line of sight; measurement of radial velocities of stars; and determination of the apparent brightnesses of the stars.

Many distinguished astronomers took an active part in this work. S. A. Mitchell, who later became the director of the University of Virginia's McCormick Observatory, and his successor in Virginia, H. L. Alden, were both at



The 40-Inch Telescope of the Yerkes Observatory

one time or another connected with the Yerkes Observatory. F. Slocum, later director of the Van Vleck Observatory, Wesleyan University, and O. J. Lee, later director of the Dearborn Observatory, Northwestern University, were at different times in charge of the solar and parallax observations. After the retirement of Prof. Burnham the work on visual double stars was continued by G. Van Biesbroeck. Prof. Barnard's place was taken by F. E. Ross after the former's death in 1923.

Prof. Frost retired from the directorship in 1932 and was succeeded by the writer of this article. It became more and more evident that the 40-inch telescope was no longer adequate to provide astrophysical material in those branches of the science which employ spectrographs of high dispersion or photometers of very high precision. In 1933 an agreement was completed with the University of Texas providing for the joint operation of a large reflecting telescope, to be constructed from the W. J. McDonald bequest to the University of Texas. The outcome of this cooperative project was the completion, in 1939, of an 82-inch reflecting telescope on top of Mount Locke, near Fort Davis, Texas. The high elevation of almost 7,000 feet, the remarkable clearness of the air at night, the large percentage of cloudless sky, and the absence of all disturbing terrestrial lights have combined to make this an exceedingly important observing station. Until the completion of the 200-inch telescope on Mount Palomar the McDonald reflector ranked as the second largest telescope in the world.

The idea of cooperation between universities in the utilization of an expensive astronomical telescope has been entirely successful. Both universities have derived fame from the research work of the staff. Separately, neither university could have accomplished even a small fraction of the results which have accumulated during the past 8 years. In order to serve astronomical departments at other universities which have previously been deprived of the use of a large telescope, the cooperative arrangement was extended to include Indiana University and the University of Minnesota. F. K. Edmondson, of the former university, has for several years been using 100 hours of observing annually, and his institution has taken a corresponding share of the operating expenses. Similarly, W. J. Luyten, of Minnesota, makes use of 50 hours per year.

The Yerkes Observatory has had a notable record in the training of astronomers. Among its former students or research assistants were E. Hubble, E. Pettit, A. H. Joy, A. van Maanen, and Horace Babcock at the Mount Wilson Observatory; W. H. Wright at the Lick Observatory; N. T. Bobrovnikoff, P. C. Keenan, and A. J. Deutsch at the Perkins Observatory; J. A. Hynek at the McMillin Observatory, Ohio State University; G. Münch at the Tacubaya Observatory of Mexico; and many others.

The research program of the Observatory during the past 50 years followed closely the path laid out by Prof. Hale in 1897. He wanted to make the Yerkes Observatory primarily an astrophysical institution where astronomy would be coordinated with physics and chemistry. With an important exception—research in the physics of the sun—his hopes and aspirations have been fully realized. After Hale's departure for Mount Wilson the routine work with the spectroheliograph was continued for a number of years, but the results were less important than could have been hoped for. The principal reason for this decline in Hale's own field of study consisted in inability to secure the services of a competent solar physicist.

As a result of scientific developments during the war there has been an enormous increase in the scope of astronomy during the past five years. Fifty years ago the observable part of the spectrum extended from about H and K of ionized calcium to about H_α. The violet limit was set by the transmission of the 40-inch objective and of the dense flint-glass prisms of the stellar spectrograph. The red limit could be reached only with very long exposures by the use of specially sensitized photographic plates. In 1947 the violet limit was extended to about λ 2,000 by the use of spectrographs mounted inside V-2 rockets, and the red limit was extended through the use of micro-wave and radio-wave techniques. Electronics has become an important tool in many astronomical investigations. These and other developments have made it necessary to redirect the work of the Yerkes Observatory and to spend time and energy in the preparation of a new plan of research.

In connection with this need for long-range planning it has been decided to reorganize the structure of the astronomical institutions of the University of Chicago and the University of Texas. The Department of Astronomy will henceforth consist of four units: the two observatories, Yerkes and McDonald, under the directorship of G. P. Kuiper; a section of theoretical astrophysics, which will also be responsible for maintaining the advanced teaching at Yerkes, under S. Chandrasekhar; the *Astrophysical Journal*, with W. W. Morgan as the managing editor; and the teaching section on the campus in Chicago. All four sections will be coordinated by the present writer as chairman of the Department and as honorary director of the two observatories. Under the new arrangement the writer will devote most of his time to research, as well as to the broader policies of the Department; G. P. Kuiper will have charge of the administration of the two observatories; and W. A. Hiltner will continue to serve as assistant director.

NEWS
and Notes

Henry Norris Russell, retired research professor of astronomy and director, Princeton University Observatory, has been appointed research associate of the Harvard College Observatory.

Linus Pauling, chairman, Chemistry and Chemical Engineering Division, California Institute of Technology, has recently returned from England, where he received honorary D. Sc. degrees from Cambridge University and the University of London, and participated in the International Congress of Pure and Applied Chemistry. Dr. Pauling will return to England in December as Eastman professor at Oxford University. The Eastman professorship is awarded periodically to outstanding American scholars and scientists.

William S. Wilson, head, Department of Physical Sciences, Georgetown College, Georgetown, Kentucky, has been appointed professor of chemistry and head, Department of Chemistry, University of Alaska, College, Alaska.

Barry G. King, formerly assistant professor of physiology, College of Physicians and Surgeons, Columbia University, and during the war, head, Aviation Facility, Naval Medical Research Institute, has been appointed chief, Division of Aeromedical Design and Materiel, Medical Service, Civil Aeronautics Administration.

William H. W. Komp, sanitary engineer director, U. S. Public Health Service, and consultant in malariology to the Division of Health and Sanitation, Institute of Inter-American Affairs, is being transferred from the Panama Canal Zone to the new Division of Tropical Diseases, National Institute of Health, Bethesda, Maryland.

George E. Large, Department of Civil Engineering, Ohio State University, has been appointed chairman of that Department, effective October 1, succeeding **Clyde T. Morris**, who retires this summer after 41 years of service at Ohio State.

George Hugh Berryman, formerly director, Medical Nutrition Laboratory, Office of the Surgeon General, has been appointed chief, Nutrition Branch, Quartermaster Food and Container Institute for the Armed Forces, Chicago.

Frederick S. Nowlan, of the University of British Columbia, Vancouver, has been named visiting professor of mathematics in the Chicago Undergraduate Division of the University of Illinois on Navy Pier.

Harry F. Herbrandson, fellow, Harvard University, has been appointed assistant professor of chemistry, Union College, Schenectady, New York.

Harvey L. Lantz, president of the Iowa State Horticultural Society and on the pomology staff of Iowa State College since 1918, has been appointed head of the pomology subsection of the Iowa Agricultural Experiment Station.

Ira D. Cardiff, Washington Dehydrated Food Company, Yakima, Washington, received the honorary D. Sc. degree from Knox College at its recent commencement.

W. Storrs Cole, professor of geology, Cornell University, has been appointed chairman, Department of Geology.

Charles A. Fowler, Jr., assistant professor of physics, University of California, Berkeley, has been named associate professor of physics on the Seeley W. Mudd Foundation and head, Department of Physics, Pomona College.

Albert F. Blakeslee, Smith College Genetics Experiment Station, who has been a corresponding member of the French Academy of Sciences since 1935, has received notice of a decree of the French Republic signed by Premier Paul Ramadier approving his election as an "Associé étrange" of the Académie des Sciences and the Institut de France. Dr. Blakeslee is the representative of botany among the foreign associates, whose number is limited to 12. He takes the place of the late Simon Flexner, who was director, Rockefeller Institute for Medical Research.

William Hovanitz, Laboratory of Vertebrate Biology, University of Michigan, has returned to Ann Arbor after spending six weeks on a population study of arctic butterflies in Northern Alberta and the Northwest Territories under the sponsorship of the Arctic Institute of North America.

Sidney Kaye, toxicologist, St. Louis Police Department, Missouri, has been appointed toxicologist to the Chief Medical Examiner for the Commonwealth of Virginia, Richmond.

Grote Reber, radio engineer on military radar and communication equipment, Stewart-Warner and Belmont Radio Corporations, has been appointed to the staff, National Bureau of Standards, to investigate cosmic and solar radio noise and to supervise the erection of a German Giant Wurzburg, an extremely large and powerful radar device, to be used to detect solar and cosmic radiation penetrating the earth's atmosphere.

Harold E. Finley, chairman, Department of Biology, Morehouse College, Atlanta, Georgia, has been appointed professor of zoology and head, Department of Zoology, Howard University, Washington, D. C.

H. P. Robertson, Princeton University, will be located at the Norman Bridge Laboratory of Physics, California Institute of Technology, as professor of mathematical physics as of September 15.

Grants and Awards

The Laurentian Hormone Conference has received from the Roche-Organon Company of Nutley, New Jersey, a gift of $15,000 to establish three awards in endocrinology. These will be assigned for 1947 at the Conference at Ste. Adele, Quebec, September 8–13. One award of $5,000 will be made for outstanding recent research in each of the fields of endocrine interest: animal experimentation, hormone chemistry, and clinical endocrinology.

The Committee on Awards consists of Edwin B. Astwood, Thomas F. Gallagher, Roy G. Hoskins, Allan T. Kenyon, Robert L. Noble, and Abraham White.

The Agricultural and Mechanical College of Texas has received a grant of $6,000 from the Research Corporation for the purchase of the Tiselius Adsorption Apparatus and the support of work on lipids by Ralph T. Holman, Department of Biochemistry and Nutrition.

Sidney P. Colowick, Public Health Research Institute of the City of New

York, will receive the $1,000 Eli Lilly and Company Award in Biological Chemistry at the 112th national meeting of the American Chemical Society, to be held in New York City September 15–19, in recognition of his contributions to the knowledge of enzymes. Presentation of the award will be made at a general assembly of the Society Monday evening, September 15. Dr. Colowick's award address on "Hexokinase and Phosphofructokinase" will be delivered at a symposium on "Studies on Enzymes," to be conducted by the Society's Division of Biological Chemistry, September 17.

Colleges and Universities

Harvard University's 11-inch Draper refractor telescope will be shipped to Sun Yatsen University Observatory, Canton, China, on a long-term loan, according to an announcement by Harlow Shapley, director of the Harvard College Observatory. The Chinese residents of Greater Boston have provided the funds for dismantling and shipment to the Chinese observatory, probably the only Chinese institution offering courses in astronomy at this time. Used in the discovery of the first spectroscopic binaries, the Draper telescope is equipped with a correcting lens, has a focal length of 153 inches, and gives photographs having a scale of 53 seconds/millimeter. Built originally for the Lisbon Observatory, Portugal, the telescope was acquired in 1880 by Dr. Henry Draper, who made the first photograph of the Orion nebula while it was in his observatory at Hastings-on-Hudson, New York. In 1886, his widow donated it to Harvard University, where it has been in continuous service ever since.

The University of Cincinnati Observatory has been designated by the International Astronomical Union as the international clearinghouse and publishing center for data pertaining to asteroids. The work will be under the direction of Paul Herget, director of the Observatory and professor of astronomy. Dirk Brouwer, director, Yale University Observatory, and chairman, I.A.U. Commission for Minor Planets, has invited Dr. Herget to take over the editing and publication of the Union's "Minor Planet Circulars." Astronomers in all parts of the world have been invited to send their asteroid observations to Dr. Herget, whose new duties cover work formerly carried on in Berlin.

The Ohio State University is assembling a classification system for more than 11,000 welding patents now in the Davis Welding Library. **W. H. Simon,** University of Toronto, is in charge of the project, which is being financed by the A. F. David Welding Engineering Scholarship and Library Fund. The new classification will enable industries, students, and research workers to obtain more readily information on all patents granted in their specific lines.

The Department of Physics, Rutgers University, has installed a helium liquefier capable of producing temperatures as low as −458°F. The liquefier, a Collins Helium Cryestat, designed by Samuel C. Collins, *professor of mechanical* engineering, Massachusetts Institute of Technology, and erected at a cost of approximately $20,000, will be used in fundamental studies of the structure of matter, a Rutgers research project sponsored by the U. S. Navy, the Research Corporation of New York, and the Rutgers Research Council. Frank G. Dunnington, head, Department of Physics, is in charge of the project.

Meetings

A three-day clinical conference on *diagnosis and treatment* of poliomyelitis will be held at Warm Springs, Georgia, September 15–17. The conference, which marks the 20th anniversary of the founding of Georgia Warm Springs, will be led by about 20 authorities in the fields of neurology, pathology, pediatrics, orthopedics, and physical and internal medicine. The papers and discussions will constitute a book on diagnosis and treatment of the disease, to be published next year. Demonstrations of modern methods of treatment will be given by the medical staff of the Warm Springs Foundation. Physicians interested in attending the conference should communicate with the Georgia Warm Springs Foundation, 120 Broadway, New York 5, New York.

The 21st Regional Meeting of the American Geophysical Union will be held as a general meeting of the Union on September 17–20. On September 17 at Wesleyan University, Middletown, Connecticut, there will be a conference on Major Problems in the Tectonophysics of the New England Area, under the chairmanship of Joe Webb Peoples, Department of Geology; at Woods Hole Oceanographic Institution on September 18 Columbus O'D. Iselin, director, will lead a conference on Earth Sciences From the Oceanographic Point of View; and on September 18–20, at the Institute of Geographic Exploration, Harvard University, there will be a conference on Meteorology, Hydrology, and Cosmic Phenomena, under the co-chairmanship of C. F. Brooks, director, Blue Hill Observatory; Harlan T. Stetson, director, Cosmic Terrestrial Research Laboratory, M. I. T.; H. G. Houghton, head, Department of Meteorology, M. I. T.; and H. B. Kinnison, district engineer, U. S. Geological Survey, Boston. Further details may be obtained from conference chairmen or from Richard M. Field, general chairman, South Duxbury, Massachusetts.

The New York Academy of Medicine will hold its 20th Graduate Fortnight October 6–17 at 2 East 103rd Street, New York City. The program, devoted to Disorders of Metabolism and the Endocrine Glands, will be composed of morning panel discussions, afternoon clinics, evening lectures, scientific exhibits, and demonstrations. The lectures will include: October 6, "The Diseases of Adaptation, With Main Emphasis Upon Hypertension," Hans Selye, University of Montreal, and "Adaptation Syndrome in Man," John S. L. Browne, McGill University Clinic, Royal Victoria Hospital, Montreal; October 7, "Energy Metabolism in Obese Persons," Louis H. Newburgh, University of Michigan Medical School, and "Psychological Aspects of Obesity," Hilde Bruch, College of Physicians and Surgeons, Columbia University; October 8, "Relation of the Adrenals to Immunity," Abraham White, Yale University, and "Clinical and Experimental Studies on Adrenal Cortical Hyperfunction," Louis J. Soffer, Mount Sinai Hospital; October 9, "Metabolic Consequences of Immobilization," John E. Deitrick, Cornell University Medical College, and "Use of Androgens in Women," Ephraim Shorr, Cornell University Medical College; October 10, "Studies in Intermediary Metabolism Conducted With the Aid of Isotopic Tracers," DeWitt Stetten, Jr., Harvard University Medical School, and "The Excretion of Urinary Steroids in Health and in Disease," Konrad Dobriner, Sloan-Kettering Institute for Cancer Research; October 13, "Disturbances in Electrolyte Metabolism in Man and Their Management," Daniel C. Darrow, Yale University School of Medicine, and "Role of Amino Acids in Nutrition," William C. Rose, University of Illinois; October 14, "Metabolic Functions in Old Age," Nathan Shock, U. S. Public Health Service, Baltimore City Hospital, and "General Aspects of Cushing's Syndrome," E. C. Reifenstein, Jr., Sloan-Kettering Institute for Cancer Research; October 15, "Hormonal and Chemical Factors Regulating Thyroid Function," Rulon W. Rawson, Harvard University Medical School, and "Some Clinical Experiments With Antithyroid Compounds," Edwin B. Astwood, Joseph H. Pratt Diagnostic Hospital, Boston; October 16, "Testicular Dysfunction, Some Clinical Aspects," E. Perry McCullagh, Cleveland Clinic, and "Use of Androgens in Men," Carl G. Heller, University of Oregon Medical School; October 17, "Why Do Women Abort?", Arthur T. Hertig, Harvard University Medical School, and "Morphological Basis for Menstrual Bleeding," Joseph E. Markee, Duke University. The registration fee is $5.00. Additional information may be secured from Dr. Mahlon Ashford, 2 East 103rd Street, New York 29, New York.

The Fourth International Congresses on Tropical Medicine and Malaria will be held in Washington, D. C., May 10–18, 1948, under the sponsorship of the Department of State, with the cooperation of 5 other government agencies and 15 scientific societies. Over 60 governments have been invited by the Department of State to send official delegations. As one of the sponsoring societies, the AAAS is represented on the Organizing Committee by Ernest Carroll Faust.

The 12 sections of the scientific program, with their conveners, will be: Research and Teaching Institutes (W. A. Sawyer); Tropical Climatology and Physiology (D. B. Dill); Bacterial and Spirochetal Diseases (T. B. Turner); Virus and Rickettsial Diseases (J. R. Paul); Malaria (M. F. Boyd); Helminthic Diseases (W. W. Cort); Protozoan Diseases (E. C. Faust); Nutritional Diseases of the Tropics (T. T. Mackie). Tropical Dermatology and Mycology (F. D. Weidman); Tropical Veterinary Medicine (R. A. Kelser); Public Health (H. E; Meleney); Medical and Veterinary Entomology (F. C. Bishopp). Officers for the Congresses will be elected at the opening sessions of the plenary and sectional meetings.

There will be scientific and commercial exhibits related to tropical medicine and also motion pictures. Visits will be made to the laboratories of the Department of Agriculture in Beltsville, to the National Institute of Health in Bethesda, and to other institutions in and around Washington.

Two special evening sessions will be held in the Departmental Auditorium in recognition of triumphs of medical science in the tropical field. The first will commemorate the demonstration of the mosquito transmission of yellow fever by Walter Reed and celebrate his admission to the Hall of Fame. The second will commemorate the 50th anniversary of the discovery by Ronald Ross of the method of malaria transmission.

Physicians, scientists, and other professional persons with suitable qualifications and interest in tropical medicine will be enrolled. Those contemplating attendance should write to the Executive Secretary, Fourth International Congresses on Tropical Medicine and Malaria, Department of State, Washington 25, D. C., for the preliminary announcement and the form for advance registration and hotel reservations.

MRC News

The Committee on Growth, acting for the American Cancer Society, is entertaining applications for grants and fellowships. Applications for extension of existing Grants in Cancer Research will be received until October 1; applications for new grants, until November 2. Applications for Fellowships and Senior Fellowships in Cancer Research may be submitted until December 1.

Final decision on applications submitted during this period will be made, in most cases, soon after February 1. Grants approved at this time ordinarily will become effective July 1, 1948. Fellowships may begin at any time determined by the Committee, although these will also usually take effect on July 1.

During the past two years the American Cancer Society, acting upon the recommendation of the Committee on Growth, has awarded 176 grants and 47 fellowships, representing a total expenditure of some $2,700,000. The Committee will continue to recommend support of biological and clinical research dealing broadly with phenomena relating to growth, typical or neoplastic. In the formulation of this program the Committee will be guided, as in the past, by the advice of some 120 scientists, grouped in 20 panels comprising its Sections on Biology, Chemistry, Physics, Chemotherapy, Clinical Investigations, and Fellowships.

Communications regarding grants or fellowships should be addressed to: Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

A comprehensive survey of food and nutrition research currently active in the United States is being undertaken by the Food and Nutrition Board with the support of the Quartermaster Food and Container Institute for the Armed Forces. This is a unique effort to compile a detailed record of research in progress in a special field which cuts across so many divergent interests. A register of the type proposed will not only facilitate the coordination of peacetime research in relation to national security and public welfare but will also serve as a basis for quick mobilization of food research resources in event of national emergency. The survey will cover all phases of food and nutrition research, including chemical, physiological, microbiological, technological, psychological, and basic economic studies. Correlation of such studies with regard to health, acceptability, stability, utility, and economy of food will be made.

Subject listings of research in progress pertaining to foods and nutrition are being obtained from directors of research in industry, universities, government, and other agencies. As a supplementary source of information, food and nutrition projects receiving financial support from foundations, public trusts, industry, and other funds are being recorded. The information received will be so classified and coded that any phase of research in progress can be readily extracted and correlated with other phases.

A roster of personnel engaged in food and nutrition research is also being developed in collaboration with the Office of Scientific Personnel.

C. G. King, scientific director, Nutrition Foundation, is chairman of the Committee on Survey of Food and Nutrition Research which will supervise the project and collaborate in the preparation of periodic reviews and reports. Mildred Ragan, technical secretary for the Committee, and LeRoy Voris, executive secretary, Food and Nutrition Board, are handling the operational details for the National Research Council.

Recent Deaths

William W. Watts, 87, emeritus professor of geology, Imperial College of Science and Technology, died in London on July 30.

George H. Hallett, 76, professor emeritus of mathematics at the University of Pennsylvania, died August 13 in West Chester, Pennsylvania.

Terence Thomas Quirke, 61, professor of geology, University of Illinois, died August 19 of a heart attack. Dr. Quirke is the author of a comment appearing in this issue.

Boyd Coe Dennison, 66, professor of electrical engineering at the Carnegie Institute of Technology, died August 19 in Pittsburgh, Pennsylvania.

Comet Wirtanen, a new comet named for its discoverer, C. A. Wirtanen, was seen for the first time in California on July 18. Two observations have since been reported to the Harvard College Observatory from Lick Observatory, Mount Hamilton, California, according to announcement by Science Service. The comet, which can be seen only with a powerful telescope, is traveling slowly north and west near the celestial equator between the constellations Aquarius and Aquila and is of the 12th magnitude.

The National Government of China has announced a revised set of organic laws for the Academia Sinica, the National Academy of China. The revision has to do mainly with election of academicians from among Chinese scholars of distinction. The Academy, founded in 1926 as the highest academy of learning in China, is directly under the National Government, from which it receives financial support. Its first president was Tsai Yuen-Pei, who served until his death in 1940, after which Chu Chi-Hua, educator, was appointed acting president.

Aside from coordinating and promoting research in all branches of organized knowledge, the Academy's laws provide for the establishment of some 23 research institutes. At present only 13 are organized, each with its own director, research staff, technicians, and clerks: Mathematics, Astronomy, Physics, Chemistry, Geology, Zoology, Botany, Meteorology, History and Philology (divided into sections on History, Philology, Archaeology, and Ethnology), Social Sciences, Medicine, Engineering, and Psychology. The institutes are administered by a secretariat headed by a secretary general and a number of staff members appointed by the president. A. Pen-tung Sah is the present secretary general with a main office at Chi Ming Ssu, Nanking, and a branch at Shanghai (320 Yoyang Road).

The new provision for election of Academy members is in line with that of academies in other nations. Following election of an initial group of 80–100 members from nominees of various organizations and institutions in China, a maximum of 15 may be elected each year. There will also be a representative Council, members of which will serve for three years.

In addition to monographs published by the various institutes, the Academia Sinica publishes two journals: *Science Record*, containing brief original scientific articles in English, French, or German, which has been issued twice since 1941 under the chief editorship of Y. H. Woo, physicist; and *Shyue Shuh Hueh Kan*, published in Chinese, also issued only twice since 1941, which contains review articles, biographies of scholars, and abstracts of research work.

The U. S. Atomic Energy Commission has appointed an advisory Scientific Personnel Committee to study employment conditions and problems of scientific and technical personnel in the research institutions which are working on the Atomic Energy Commission program. Its report will include detailed recommendations and supporting data based on practices in government, industry, and educational institutions, taking into account the unique mission of the Atomic Energy Commission. This report, which the Committee will submit to the Commission, will recommend personnel policies for the Commission research program to enable the Commission to obtain the services of qualified research personnel without adverse effect upon academic and industrial employers. The Committee, which will be a continuing group, includes the following members: F. Wheeler Loomis, professor of physics, University of Illinois, chairman; Morris P. Carpenter, executive director, Whiting Laboratories, Standard Oil Company of Indiana, Whiting, Indiana; Farrington Daniels, chairman, Board of Governors, Argonne National Laboratory, and professor of chemistry, University of Wisconsin; W. A. Hamor, associate director, Mellon Institute; William B. Harrell, business manager, University of Chicago; and Lawton D. Geiger, Iowa Area Manager, U. S. Atomic Energy Commission, Ames, Iowa, executive secretary.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, lists the following wanted chemicals: dodecamethylene chloride; 2,7-diaminofluorene; brazilin; desoxyguanosine; trimellitic acid; phloretin; perthiocyanicacid; carbonyl sulfide; deuteroammonia; diborane; lithium deuteride; furazan; 1,3,4-oxadiazole; 3-phenylcyclopentene; benzochrysene; benzoperylene; benzofluorene; jojoba oil; ferrous glycinate; and vinyl dimethylamine.

The 10th Annual Louis Gross Memorial Lecture will be delivered at the Jewish General Hospital, Montreal, under the auspices of the Montreal Clinical Society, October 29, at 8:30 P.M., by I. Arthur Mirsky, director, May Institute for Medical Research, and associate professor of experimental medicine in psychiatry, University of Cincinnati. Dr. Mirsky's topic will be: "Biology of Metabolic Disease in Man."

The Department of Biology, U. S. National Museum, was reorganized on July 31 to form two separate Departments, Zoology and Botany. The Department of Zoology for the present will include the Divisions of Mammals, Birds, Reptiles and Amphibians, Fishes, Insects, Mollusks, Marine Invertebrates, and Echinoderms, **Waldo L. Schmitt,** head curator of Biology, becoming head of Zoology. The Divisional staffs remain unchanged. The newly-established Department of Botany, with **E. P. Killip** as head curator, comprises the Divisions of Phanerogams, Grasses, and Cryptogams. **Jason R. Swallen** is curator of the Division of Grasses. Mr. Killip will for the present act also as curator of the other divisions. Associate curators **E. C. Leonard, C. V. Morton,** and **E. H. Walker** are assigned to the Division of Phanerogams, and **Paul Conger,** in charge of the Section of Diatoms, is assigned with his collections to the Division of Cryptogams. It is expected that this reorganization will enable the staff working with the collections designated as the U. S. National Herbarium to give them better care and to respond more promptly to the many requests for information received from all parts of the world.

The National Bureau of Standards, in cooperation with the Office of Naval Research, has just published in looseleaf form the first tables in a new and comprehensive compilation of "Tables of Selected Values of Chemical Thermodynamic Properties," which bring together for the first time all available published data of chemical thermodynamic properties. One set of these tables, which are published in three parts, is being furnished to each university Department of Physics, Chemistry, or Engineering. U. S. Government laboratories, research institutions, and industrial laboratories may obtain one set each on request to the Bureau.

Make Plans for—

American Roentgen Ray Society, September 14–19, Atlantic City, New Jersey.

American Chemical Society, September 15–19, New York City.

Illuminating Engineering Society, September 15–19, New Orleans, Louisiana.

American Institute of Electrical Engineers, Middle Eastern District Meeting, September 23–25, Dayton, Ohio.

American Public Health Association, October 6–10, Atlantic City, New Jersey.

American Academy of Ophthalmology and Otolaryngology, October 12–17, Chicago.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS

by Readers

In solar radiation work the unit called the gram calorie per square centimeter per minute is very frequently used; for longer time intervals, such as an hour or day, for example, the gm cal/cm^2/hr or gm cal/cm^2/day is used, when appropriate. These units are somewhat cumbersome to write and even more awkward to say.

A more convenient unit is therefore needed. According to F. Linke (*Handb. Geophys.*, 1942, 8, 30) the "langley" has been proposed to designate the gm cal/cm^2/min, in honor of Samuel P. Langley, who, as the first director of the Astrophysical Observatory of the Smithsonian Institution, contributed greatly to the study of solar radiation and its depletion by various gases in the earth's atmosphere.

However, in view of the need of considering longer time intervals than a minute, it is herewith proposed that the "langley" be defined as the gm cal/cm^2, where "gm cal" denotes the 15°C gm cal. It is also proposed that the written abbreviation of "langley" be "ly"; to shorten the word in other ways might tend to confuse it with other units.

Having adopted the new unit we may now speak of the langley per minute, the langley per hour (and so forth), which will be written as ly/min and ly/hour. (L. B. ALDRICH, *Smithsonian Institution, Washington, D. C.*; H. WEXLER and S. FRITZ, *U. S. Weather Bureau, Washington, D.C.*; I. F. HAND, *U. S. Weather Bureau, Boston*; A. COURT, *Office of the Quartermaster General*, and MAJOR W. P. MELLEN, *Air Corps, Washington, D. C.*)

A remarkable set of rainbows was seen from 8:00 until about 8:15 P.M. (C.D.T.) on July 20, 1947, at Urbana, Illinois. The main primary rainbow showed a continuous band of clear color. The most unusual part of this bow was the brilliance of the violet band, which at times exceeded in intensity that of the blue and green bands. From top to bottom the colors in a primary rainbow run: red, orange yellow, green, blue, indigo, violet. Usually the indigo and violet bands are quite faint, whereas in this case they were unusually bright.

A secondary rainbow was very plain, above and outside the arc of the primary bow. In this, as is usual, the order of colors was reversed, with red at the bottom and green above. It is uncommon for the blue, indigo, and violet bands to show above the green in the secondary rainbow, and this was no exception. However, the width of the secondary bow, even without the blues, was about equal to that of the whole primary bow. Between the primary and secondary bows the sky appeared to be lacking in light. It was dark, leaden gray in color.

Beneath and within the curve of the primary rainbow were the so-called supernumerary rainbows, very brilliantly exhibited. Although these are referred to as "familiar" phenomena by W. J. Humphreys in his *Physics of the air* (1920, pp. 456–482), they have never before been seen by the writer or by many other mature persons. In this case the position of the sun, due to the time of day, was almost ideal for rainbow phenomena. The whole band of rainbows appeared to lie within a vertical angle of about 20°, from about 60–40° above the horizon, with the zenith of the bows in a direction about 10° S.E. from the observer. Two supernumerary bands of color beneath the unusually brilliant violet of the primary bow were visible to this observer, and Lt. Col. J. S. Shaplund, C.E., U. S. Army, told the writer that he was able to distinguish still another inner band from his place of observation. The only colors distinguishable in these supernumerary bows were green and red-violet. The bands of green and violet were very narrow, their width being about that of green and blue only in the primary rainbow. Beneath the primary bow, ending with brilliant violet, were green, violet, green, violet, and green, violet. The first repetition of green and violet was clear over the larger part of the primary bow, but the second and third showed only from time to time and then most clearly near the zenith of the arcs.

Supernumerary rainbows are said usually to show only green and red. They are interference phenomena, and in the case here reported it seems as if the red was superposed over the violet so as to produce the unusually brilliant bands of red-violet even in the primary bow. A complete explanation of these phenomena is presented by Humphreys, as noted above. (TERENCE T. QUIRKE, *Department of Geology and Geography, University of Illinois.*)

Everyone who has had occasion to teach vitaminology must have experienced considerable difficulty with the commonly accepted terminology, both because of the cumbersomeness and because of the incorrect implications of some of the terms used. In the interest of further simplification and clarification, the following suggestions are offered:

(1) Since vitamin A activity results from activation of carotene, it is suggested that "accarene" be adopted as an official name. This term is a condensation which implies nothing as to its physiological action or therapeutic effects; it is a short term, and yet the chemical relations are not too completely obscured. The rather commonly used "axerophthol" is objectionable not only because of its length and rather awkward pronunciation, but more importantly, because it implies one rather superficial and nonspecific therapeutic influence. This is always objectionable, because it implies that the vitamin is of importance only when deficiency occurs.

(2) It is suggested that "ossiferol" be substituted for "calciferol" as a specific designation for vitamin D_2. The objection to the older name is that it leaves out of consideration all reference to the influence of the vitamin on the metabolism of phosphorus in relation to bone. Certainly, this phase of its action is as important, if not more so, than the influence on calcium. "Calciferol" does have the merit of referring to a physiological process but to only a limited part of it.

(3) It is suggested that, since vitamin D_3 is produced by activation of 7-dehydrocholesterol, this latter term be telescoped to "sedesterol." As in the case of vitamin A, there is no implication of chemical nature or of physiological action; the word is euphonious and not cumbersome.

It seems desirable that all names of vitamins be based on (a) chemical composition, (b) physiological rather than therapeutic action, or (c) be distinctive but nonspecific. "Ascorbic" acid is especially objectionable because it refers to a deficiency state rather than to chemical composition or physiological function in healthy organisms. From this point of view, it would be highly preferable to restore the original chemical designation of hexuronic acid.

The above criticisms apply equally well to tocopherol as a designation for vitamin E activity. However, no suggestion is made for any change until its function in the human is better understood. (C. I. REED, *University of Illinois, Chicago Professional Colleges.*)

Book Reviews

Fundamental theory. A. S. Eddington. Cambridge, Engl.: at the Univ. Press, 1946. Pp. viii + 292. 25/-.

This posthumous work of the great British astronomer, which supersedes his *Relativity theory of proton and electron* (Cambridge, 1936) and *The combination of relativity theory and quantum theory* (Dublin, 1943), was prepared for the press by E. T. Whittaker, of Edinburgh University. It represents the clearest expression which Sir Arthur achieved of his theory of the relation of relativity theory and quantum theory and his deduction of the value of certain fundamental constants of nature, such as the masses of the electron and proton, the fine structure constant, the rate of recession of the nebulae, the number of particles in an Einstein universe, and the nuclear-range constant. On pages 66 and 105, and in Chapters IX and XI are set forth the *calculated* values of more than 30 constants of nature, nearly all of which are in most remarkable agreement with experiment. The reviewer knows of no other theory which achieves such accuracy of prediction over so wide a range of physical phenomena.

Since Eddington worked almost completely alone for the last 20 years of his life, the hidden assumptions in his physical reasoning are not always the same as those of more well-known schools of quantum theorists. This accounts for the fact that those who approach his theory after a thorough grounding in more conventional methods find it very difficult to understand and even repellent. Further, since he created his theory by daring intuitions rather than by careful argumentation (as happens with any essentially new theory) and since it seems to require for its adequate formulation much abstract algebra with which Eddington was not too well acquainted, there are occasional gaps and even inconsistencies in the logic of his presentation. However, even though Eddington's arguments are not always convincing, his formulas are related to one another in such an astonishing way, which cannot be explained by chance, and result in the prediction of so many facts in complete agreement with experiment that the reviewer is persuaded that the theory is essentially correct while he admits that the rationale of the dependence of the formulas on Eddington's basic notions is still far from satisfying.

Eddington's reputation as an *astronomer* is already secure. If the above judgment as to the value of *Fundamental theory* proves to be well founded, he will rank with Newton and Einstein as one of those few geniuses who have effected fundamental revolutions in our knowledge of the physical world.

A. J. COLEMAN

13 rue Calvin, Geneva, Switzerland

Time, knowledge, and the nebulae: an introduction to the meanings of time in physics, astronomy, and philosophy, and the relativities of Einstein and of Milne.

Martin Johnson. New York: Dover, 1947. Pp. 189. $2.75.

Milne's Kinematical Relativity, which is derived from definitions of distance and time in terms of simultaneity and succession at the observer, was first published some 15 years ago. It is considered by many (including Dr. Johnson) to be as great a philosophical advance as Einstein's Relativity of 1904 or Newton's Laws of Motion.

In this little book Dr. Johnson presents in readable form a survey of various relativities and cosmologies together with their philosophical implications. Two basic themes are developed. The first concerns the nature of time, this leading to a rejection of causality in favor of "functional dependences," and to a critical examination of the various contexts in which "time" is used. The second and more important theme has to do with the *Principle of Communicability*, proposed by Johnson as the philosophical basis of all science. On this principle, the relativity transformations and time scales of Milne are shown to be necessary in order that experience (*i.e.* the Laws of Physics) may be communicated intelligibly from one observer to another.

Many scientists will want to bring themselves up to date on relativity and the changing philosophy of science by reading this excellent work. Nonmathematical readers will find most of the mathematics easy to follow, although the addition of simple space-time diagrams would have been an immense help to the uninitiated reader. It is unfortunate, too, that there is scarcely mention of geological time, of time in evolution, or of accelerated reference systems. The spiral form and the red-shifts of the spiral nebulae are discussed fully, but the significance of Hubble's surveys determining density distribution is ignored.

Time, knowledge, and the nebulae should stimulate further research among astronomers and physicists by pointing to new possibilities in the interpretation of data. As Prof. Milne says in the forward: ". . . only . . . through the consideration of the problem of time, can the important questions of physics be properly investigated."

THORNTON PAGE

Yerkes Observatory, Williams Bay, Wisconsin

Methods of mathematical physics.

Harold and Bertha Swirles Jeffreys. Cambridge, Engl.: at the Univ. Press, 1946. Pp. vii + 679. $15.00.

The authors preface their large Cambridge volume with the statement: "This book is intended to provide an account of those parts of pure mathematics that are most frequently needed in physics." This they have done by giving an account of fairly extensive topics, principally in analysis beyond the calculus, and by then applying methods developed therefrom to selected problems in physics. The consequence is a most useful compendium of special methods and results, rich in problems but somewhat lacking in general points of view which would tie the material treated into a more unified whole.

In developing the more purely mathematical topics the authors have been guided by the sound principle that high standards of rigor are as necessary for applicable as for pure mathematics; it is recognized that in order to achieve such rigor without undue complications some sacrifice of generality must be made. Thus, in proving theorems in real and complex variable, conditions are postulated which are sufficiently broad to cover the proposed applications, and the theorems are then proved with the rigor appropriate to the subject; the authors are justifiably less concerned with whether the conditions postulated are necessary for the truth of the theorem. In this spirit an admirable exposition is made of series, integration, calculus of variations, conformal mapping, linear differential equations, and a host of other topics. The chapters on vectors, tensors, matrices, and operators present and apply a wealth of useful results, but it seems to the present reviewer that their treatment from a more fundamental algebraic point of view would lead to a deeper understanding, both of the topics in themselves and of their role in modern physics.

The physical fields to which the mathematics is applied are almost as broad as physics itself—including, as they do, dynamics, hydrodynamics, elasticity, and electromagnetism, among others. It is to be observed that these applications are to specific topics in these fields and that a fuller appreciation of their significance requires some previous familiarity with the fields. Perhaps the greatest lacuna is the quantum theory, which is touched upon altogether too lightly in view of its importance in modern physics and astrophysics, and which offers an excellent opportunity to draw together several fields under a unified mathematical viewpoint.

Altogether the book offers a wealth of well-treated material which should prove most useful as a source or reference for students, teachers, and advanced workers in physical science. It is a source of gratification to note that physically and typographically the Cambridge University Press has here done a job which is well up to their high prewar standards.

H. P. ROBERTSON

California Institute of Technology

The Soochow astronomical chart.

W. Carl Rufus and Hsing-Chih Tien. Ann Arbor: Univ. Michigan Press, 1945. Pp. 24. (Illustrated.)

In the Wên Miao temple near Soochow, Kiangsu, China, there is a star map, about three feet in diameter, accompanied by a text prepared in 1193, engraved in stone in 1247. Eduard Chavannes published, in 1913, a reproduction of the chart, with a French translation of the text, but without an identification of the asterisms and stars or a translation of their names ("L'Instruction d'un futur empereur de Chine en l'an 1193, Carte astronomique," *Acad. Inscr. Belles-Lettres, Mém. Asie orientale*, 1913, **1**, 43–57). The present publication offers, in addition to a good reproduction of the star map and of the accompanying text, an introduction, a description of the star map, an annotated translation of the text, and tables of 313 asterisms and 1,440 stars, with their names and, when feasible, their identification.

The text of the "instructions for a future emperor" is a blend of cosmography and political astrology. The star map has the North Pole in the center; the three concentric circles mark the circumpolar asterisms (ca. 35°, latitude of Kai-Feng Fu, Honan, seat of the Government, 1214–67), the equator, and the limit of southern asterisms (ca. −55°). The 28 lunar mansions —of unequal extent—are shown by radial lines extending from the circumpolar circle to the rim of the map. The ecliptic has an obliquity of about 24°. The Milky Way (The River of Heaven) is outlined. The purpose of the map is primarily astrological; the identification of many stars shown on it is a hopeless task.

This publication is a companion work to "A Korean star map," by W. Carl Rufus and Celia Chao (*Isis*, 1944, 35, 316–326).

ALEXANDER POGO

Carnegie Institution of Washington

The earth and the stars. C. G. Abbot. New York: D. Van Nostrand, 1946. Pp. xii + 288. (Illustrated.) $3.75.

This book by Dr. Abbot is like a tour in the universe of space and time with a guide who is enthusiastic and optimistic and has an interest in people as well as in stars. The author impresses the reader not only with the vastness of the universe, but with its beauty, its unsolved problems, and the significance of intelligent life.

The material of the 1926 edition has been rearranged, some has been omitted, and much new has been added. The print is larger and the paper better. A few inadvertent slips have been noted which could be corrected by a sheet of errata inserted by the publisher in each copy of the book. Plates referred to in the text as XIII, XX, and XXII are missing; plates of different subjects bear those numbers.

The author begins with descriptions of appearances. Then he explains interpretations given them, from ancient myths to results obtained with modern equipment. Two chapters on the sun include a discussion of the sun's periodicities, their influence on weather, and the possibility of utilizing the power in solar radiation. So modest is the treatment of Dr. Abbot's own part in these researches that the reader would not realize how large it is. Topics related to astronomy, such as atoms, calendars, star places, and navigation, are explained. In the last chapter, "Some Famous Astronomers and Famous Instruments," are described feelingly the high lights of astronomical history from Hipparchus to the construction of the 200-inch telescope. Appendixes contain astronomical tables, a brief explanation of tides, a glossary, and an index.

LEAH B. ALLEN

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Making your own telescope. Allyn J. Thompson. Cambridge, Mass.: Sky, 1947. Pp. xi + 211. (Illustrated.) $3.50.

This volume contains a reasonably consecutive set of directions for the construction of a reflecting telescope of 6-inch aperture and 48-inch focal length. After a brief account of the discovery and development of the telescope, the author gives a list of the materials and equipment needed to make the telescope mentioned above, and proceeds to tell how to grind the mirror, prepare a pitch lap, and polish and figure the mirror. He describes the making of a diagonal mirror, but limits himself to the description of three common types of eyepieces, Huyghenian, Ramsden, and Kellner, referring the reader to other books for complete details on their construction.

Plans are given for two equatorial mountings made from standard pipe fittings. In the chapter "Aluminizing and Cleaning," the author assumes that the telescope maker will send his mirror away to be aluminized and says only that "instructions for silvering by the Brashear and other processes may be found in optics, telescope making and physics laboratory texts."

Mr. Thompson has served as an instructor in telescope-making classes at the Hayden Planetarium in New York City; his book indicates that he has met most of the problems encountered by amateurs. Many of the solutions proposed are the standard ones, tried and proven by several decades of American amateur telescope makers. Considering how often the mirror and tool stick together for an unskilled amateur, the author's suggestion, "If this occurs, use a carpenter's wooden clamps to separate them, or wedge the tool on a bench, hold a block of wood against the side of the mirror, and free it with a sharp blow of the hammer," seems like powerful medicine. A little more emphasis on prevention and one or two less drastic cures would make worthwhile additions to the book.

The author appears to be optimistic about polishing (2–6 hours, p. 67) and needlessly pessimistic about figuring (15–25 hours, p. 196). When the testing of three nearly-plane surfaces against each other is discussed (p. 102), no mention is made of 'saddle-shaped' surfaces, which are common in small sections of plate glass; no clue is given as to what may be done with them. Other small omissions are noted, but a second edition will doubtless take care of them in due time.

As it is, the book is an excellent one for the man who is making his first reflecting telescope.

CHARLES H. SMILEY

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Scientific Book Register

FEDERER, CHARLES, and FEDERER, HELEN. *Splendors of the sky*. (2nd ed. rev.) Cambridge, Mass.: Sky, 1947. Pp. 36. (Illustrated.) $.35.

GAMOW, GEORGE. *Atomic energy in cosmic and human life: fifty years of radioactivity*. Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. x + 161. (Illustrated.) $3.00.

JONES, HAROLD SPENCER. *John Couch Adams and the discovery of Neptune*. Cambridge, Engl.: at the Univ. Press; New York: Macmillan, 1947. Pp. 43. $.75.

LEY, WILLY. *Rockets and space travel: the future of flight beyond the stratosphere*. New York: Viking, 1947. Pp. viii + 3[illegible] (Illustrated.) $3.75.

SPURR, J. E. *Features of the moon*. Pt. I: *Geology applied* [illegible] *selenology; the Imbrian Plain region of the moon*. Pt. II: *The features of the moon*. Lancaster, Pa.: Science Press, 194[illegible] Pp. x + 112 (Pt. I); xiii + 318 (Pt. II). (Illustrated.) $5.00.

STERNS, MABEL. (Compiler.) *Directory of astronomical observatories in the United States*. Ann Arbor, Mich.: J. [illegible] Edwards, 1947. Pp. x + 162. (Illustrated.) $2.85.

————. *Harvard College Observatory, the first century: review of the past and a preview of the future*. Cambridge, Mass.: Harvard College Observatory, 1946. Pp. 94. (Illustrated.) $1.00.

Discharge Through Gases

Leonard B. Loeb

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IT IS PERHAPS TIMELY THAT "DISCHARGE Through Gases" should be presented before the Institution, since 1947 marks closely the 50th anniversary of the proper scientific beginning of this field of study. It is particularly appropriate that it be presented before the Institution of Electrical Engineers, since it is from the research laboratories of England that most of the early significant advances have come. The subject has a peculiar and important interest for the electrical engineer, in that we live and operate in a gaseous atmosphere. Thus, it is not surprising that limitations set by the electrical properties of the atmosphere and, in particular, its electrical breakdown are in this electrical age of considerable practical importance. When it is recognized, furthermore, that the peculiar properties of electrically conducting gases furnish important elements in modern technical advance in the form of illuminating, rectifying, and welding agencies, and agencies for electrical counting, electrical switching, and the amplifying of electrical currents, the importance of this field to the engineer is adequately established.

With the discovery of X-rays late in 1895 there came to hand a medium of producing sufficient conductivity in gases that proper study could be initiated, and in the next 10 years significant advances were made by that brilliant international group of young physicists working under Sir J. J. Thomson at the Cavendish Laboratory. As time went on, these investigators moved elsewhere and carried further the researches begun at Cambridge.

In these first 10 years most of the fundamental properties of gaseous conduction were delineated, and a general understanding of the subject was achieved. At the end of this period the lure of the exciting developments in the fields of atomic structure attracted the attention of many of these brilliant workers and drew them into other channels of endeavor. The loss of active workers, however, does not entirely account for the period of relatively slow development of the subject which followed; for it must be clear that the initial studies had gone as far as the existing knowledge and techniques of the period permitted. The later development of the Bohr atom, the discovery of the elastic electron impacts, excitation and ionization functions, inelastic impacts of the second class, and various mechanisms of secondary electron emission were essential to proper interpretation. Likewise, the vast improvements in physical techniques such as high vacua and outgassing, achievement of gaseous purity, measurement, the achievement of electrical pulses of short time intervals, and the development of high-frequency oscillographs, were perhaps even more essential to further advance.

It is accordingly not unexpected to discover that the mechanisms derived from earlier study, while correct in outline, were in many cases seriously wrong in detail and that in general the simple pictures which have now become fixed in the textbooks need radical revision. It is thus my purpose to sketch the significant advances in the various aspects of the subject and—perhaps more important—to indicate the tasks which remain to be done.

In the early studies much interest was focused on the nature and mobility of the positive and negative ions in gases, with particular emphasis on the question of whether the ion was molecular or consisted of a large cluster of molecules. Inadequate techniques and lack of gaseous purity led to completely confusing and contradictory results. When it was realized that ions could change charge, had specific affinities for certain atomic or molecular species, and that in one second of time an ion could collide with some hundred millions of molecules, the confusing results became comprehensible. Hence, in order to study ions of a known constitution with the controlled gaseous purity obtainable, it was required that ions that did not change charge be observed in short periods of time. Beginning simultaneously in the laboratories of Loeb (*45*) in Berkeley and Tyndall (*88*) in Bristol, the recognition of these difficulties led to a satisfactory solution of the problem. Particular credit must go to Tyndall and his school of able investigators who, over many years of tedious study, developed the techniques which ultimately clarified the problem (*86*). This work together with the recognition that dielectric polarization and electrostatic attraction play a role in giving a fictitious collision cross-section, independently of the size of the ion cluster, has now satisfactorily brought the theory of ionic mobilities into agreement with experiment (*48*). Notable among these theories is the one published in 1905 by Langevin (*41*) and not recognized until rediscovered by Hassé (*25*) in Bristol. Clustering of a limited and often very specific sort does occur, but is not of the extensive character originally

The 38th Kelvin Lecture was delivered in London on April 24, 1947. Through the courtesy of the Institution of Electrical Engineers *Science* has been granted the privilege of printing this lecture, which appeared in the August issue of Part I of the Journal of the Institution.

Linlithgow Library.

assumed (*87*). While much in detail yet remains to be done, the resulting information will be of value primarily to the physicist and physical chemist interested in atomic and ionic force fields and structure. It will be of no great importance in engineering applications. What the engineer must, however, recognize is that gaseous ion mobilities with ions of more than 10^{-4} second of age, except in a few special cases, can have significance unique to the particular gas conditions of a given measurement only. Thus, most values given in tables are not of general applicability even in the supposedly same gases, but may be used in roughly predicting ionic velocities in order of magnitude in practical application.

The coefficients of diffusion of ions are related to their mobilities by the classical expression, $k/D = Ne/P$, where k is the mobility; D, the coefficient of diffusion; N, the number of molecules per unit volume; e, the charge; and P, the pressure. Thus, what has been said about mobilities likewise can be said of the coefficients of diffusion with little modification.

One of the most important problems in the study of gaseous conduction and breakdown hinges on the values of the velocities of electrons in electrical fields in gases and, more in particular, on their energy distribution and their average energies. As early as 1910 it began to be recognized by Kovarick (*38*) and Franck (*21*) that in certain gases electrons generated by an ionizing agency remained free, and that even in air at lower pressures the electrons did not at once attach to molecules to yield negative ions. By 1913 Townsend (*84*) and his pupils had devised a means for studying the mobilities of electrons in gases and evaluating some sort of an average value of their energies, using the ratio of mobility to diffusion noted above. Today it is the only existing method of even roughly evaluating the energies of the electrons and relating them to the experimental parameter, X/p, the ratio of field strength to pressure, which is the determinative quantity in most measurements of gaseous behavior. In 1920 Loeb (*44*) began investigations on the conditions both of attachment of electrons to molecules in gases and of their velocities, extending the velocity measurements to higher pressures and lower X/p values, and on somewhat purer gases than Townsend. This work has been continued over the years by Loeb's students, notably Wahlin (*90*), Cravath (*12*), and later by Nielsen (*61*) and Bradbury (*8*). Today it can be said that the problem of negative ion formation is fairly satisfactorily solved, as will later be indicated, while satisfactory experimental data on electron velocities over a wide range of pressures in some standard gases now exist. This is due largely to Bradbury and Nielsen's work, using Loeb's electron filter, redesigned by them as an electrical shutter. With techniques available since World War II the velocity measurements could easily be extended in range and accuracy if required.

Stimulated by the work in the early 1920's, together with the new observations concerning the mean free paths of electrons in gases determined by Ramsauer (*66*) and later by Brode (*9*), the way was open for a theoretical study of electron velocities. This was initiated by Compton (*11*), who extended his earlier approach with classical kinetic theory procedures to give a fairly satisfactory theory of velocities of electrons of energies of below the threshold for excitation and ionization. In thus proceeding, it had been assumed that electrons moving in a field in a gas had the Maxwellian energy distribution characteristic of thermal equilibrium. Following a study of Hertz (*26*), Druyvesteyn (*17*), of the remarkable team of physicists active at the research laboratories of the Phillips Company in Holland, derived the energy distribution for electrons in gases below excitation energies with *constant* electron mean free paths. He showed that the energy distributions did not exactly follow the Maxwell law, although the law which he derived was not very radically different. This was independently rederived, using more general procedures in kinetic theory, by Cravath (*13*), Davydov (*15*), and Morse, Allis, and Lamar (*59*). Experimentally, however, the point at which Bradbury and Nielsen's values of the velocities began to deviate from the theoretical values given by Compton for different gases indicated to these workers that the departures of the energy distribution from the Maxwellian, or even Druyvesteyn form, was much more radical than anticipated. They ascribed this to the fact that the Ramsauer electron free paths for some gases increased or decreased markedly with electron energy in the regions studied and roughly indicated how it operated. The rigorous calculation up to ionizing energies was carried out by Allis and Allen (*1*) to include variable Ramsauer free paths, using a method initiated by Pidduck (*63*) and further developed by Morse, Allis, and Lamar.

The fact that the departures from the conventional distribution law are so radical and that the distribution varies extensively over the energy ranges experimentally covered makes it impossible either to interpret the meaning of the Townsend evaluation of average electron energy in terms of X/p or to apply these to an analysis of the ionization and excitation functions. Thus, probably the most important fundamental problem outstanding today is in the evaluation of electron energy distribution functions in various gases over extensive energy ranges and the relation of these to the experimental parameter, X/p. At present I see no method of approach to the solution of this problem except through the laborious and intricate method of calculation initiated by Smit in Holland (*74*). Smit has shown how to derive these functions and has calculated them fairly rigorously for helium for only four values of X/p. This work must be extended unless experimental techniques can be devised.

The increase in our knowledge of atomic structure, together with improved techniques, led to the solution of the problem of the formation of negative ions from free electrons and molecules. The work initiated by Loeb and Wahlin in 1920 and carried further by Loeb in 1923 indicated the essential soundness of the theory for this process, suggested by Thomson in 1916 (*77*). This work led to an estimate of the values of the probability of attachment of an electron to a molecule to make an ion for some gases. In 1925 V. A. Bailey (*3*), then at Oxford, showed experimentally that the probability of attachment in air decreased as the electron energy in the gas increased—a condition not recognized by Thomson. With the invention of the electron filter by Loeb, Cravath and later, more successfully, Bradbury (7) were able to measure the character of the process of the formation of negative ions. This was found to be a diversified and, in some cases, a complicated process. In only two molecular gases, O_2 and SO_2, do electrons directly attach. In these the process is one in which the electron attaches to the molecule, the low heat of ion formation going to vibrational energy of the molecular system. Unless in a relatively short time the molecule can lose this energy in impacts with other molecules, the electron will reabsorb its energy and leave the ion. The problem has been successfully attacked wave mechanically by Bloch and Bradbury (*5*), and the theory agrees with Loeb's findings (*46*) as to the energy of attachment. In other gases the energy of attachment to one of the atoms of the molecule, together with the energy of the electrons, suffices to dissociate the molecule and form the ion in a three-body process, the residual energy being taken up as kinetic energy of separation. While radiative capture of an electron yielding negative ion formation is possible, the probability is so small that ion formation takes place, if at all, only by three-body processes where the excess energy is removed in the kinetic form. As shown by Massey (*55*), certain spectroscopic states of atoms and molecules have negative heats of ion formation, and in these no electron attachment occurs. Notable among them are the $^1S_0$ and $^1\Sigma$ states (7). In such gases electrons remain permanently free. While much work still remains to be done, the data to be gained are of value primarily to those interested in atomic and molecular structure, and the present information is adequate for the engineer.

While the process of recombination of negative ions or electrons with positive ions, to annihilate the charges in the gas, was one of the first subjects studied in 1896, it has proved to be one of the most difficult and stubborn of all the problems to interpret. The basic equation for recombination reads that the loss of ions by recombinations dn in a time dt out of n ions of each sign per cm.^{3} is $dn = -\alpha n^2 dt$. Its solution indicates that, starting with n_0 positive and negative ions per cm.^{3} at $t = 0$, there will be $n = \frac{n_0}{1 + n_0 \alpha t}$ ions remaining after a time t. The quantity α is called the coefficient of recombination of ions. Early work by Thomson and Rutherford (*79*), Townsend (*80*), and especially Langevin (*40*) derived the order of magnitude of α as 10^{-6} for ions in most gases. An early theory for the value of α, deduced by Langevin, was based on assumptions which were erroneous as applied to the usual conditions met with in a gas. This, together with the complicated nature of the processes at work and the experimental limitations, imposed thwarted interpretation for many years. In general there are four possible steps in the recombination process: a diffusive approach, an active electrostatic attraction, a mutual orbital encounter, and the transfer of charge. Depending on the density of the ions, the nature of the carriers, the pressure, the temperature, and the energy of negative ion formation, some of these four processes either are the determinative factor fixing α or may even be absent. Furthermore, measurement does not yield the concentrations needed directly but gives the quantity of ions, q, in a given gross volume, V. Use of the values of concentration n determined by the ratio q/V requires, then, a random but isotropic distribution of ions in space. With some forms of ionizing agencies used such as β particles or γ rays and X-rays, this is not achieved, and n changes in time by diffusion irrespective of the recombination loss, thus complicating theory. This latter aspect is also affected by the speed of attachment of electrons to molecules to give negative ions. Finally, recombination is a slow process, and the time required to get measurable changes in concentration n by recombination is of the order of 10^{-2} second or more long. Thus, loss by diffusion of ions and especially of electrons to the walls causes trouble. The worst difficulty, however, lies in the fact that in all but the purest gases made of single types of atoms the ions change their size and character during the 10^{-2} second of measurement, thus altering α continually. As a result of a long series of investigations beginning in 1925, using the most modern techniques by Marshall (*53*), Luhr (*52*), and finally Gardner (*22*) in Loeb's laboratory, fairly good results were obtained in one gas only (O_2) by Gardner in 1938. Similar techniques were used nearly simultaneously by Sayers (*69*) for air, and while the data are good, the values cannot be compared with theory because of the heterogeneous nature of air. Even more than for ionic mobilities are the values of the coefficient of recombination dependent on ionizing conditions, gaseous purity, and composition, so that practically all data given in the literature are unreliable. For purposes of calculation the values of the coefficient given by Gardner and Sayers may be used as orienting magnitudes for ion-forming gases. The coefficient of recombination for *electrons* and positive ions cannot be evaluated in gases under normal conditions because of its low value in contrast to rapid electron diffusion. Kenty (*35*) and Mohler (*58*) and associates have evaluated it for arc plasma and obtained values of the order of 2×10^{-10}.

which is higher than wave mechanical theory yields but very small compared to the values of about 2 × 10^{-6} for air and O_2. Later work of Sayers on arcs and of Craggs on spark channels have confirmed and extended these findings.

In theory the mechanism of recombination depends on the relative importance of the four steps indicated. It thus depends on the distribution of ion pairs in space, the nature of the carriers, the pressure, the temperature, and the density of ionization in a complicated fashion. Thus, much confusion has existed for a long time. Lately Jaffé (*31*) has studied the general problem and indicates that for very high gaseous densities the original Langevin theory applies. From some 10 atmospheres down to 2 atmospheres, a diffusion theory of Harper (*24*) which, except for an undefined constant, is in form the same as Langevin's equation, is valid. Thomson's (*78*) equation is applicable and has been experimentally established to hold from about 1 atmosphere down to 10^{-2} mm. pressure. Below this, a simple theory proposed by Loeb (*47*) is indicated. For recombination under α-particle ionization, the theory developed by Jaffé (*32*) must be used. No adequate quantitative theory has yet been derived for initial recombination with X-ray ionization for time intervals shorter than 0.1 second.

In the study of gaseous discharges such as arcs or glows with ion concentrations in the order of 10^8 ions/cm.^{3}, much information of value can be obtained by the use of electrical probes. With such electron and ion densities and greater ones, the Maxwellian energy distribution again begins to appear, despite the action of the field. Thus, good approximate values of ion and electron densities, ion and electron energies, space, and wall potentials can be derived. These techniques were initially developed by Langmuir and Mott-Smith (*43*), Compton (*42*), Schottky (*71*), and others. In recent years advances enabling the measurements to be analyzed to give electron energy distributions of non-Maxwellian form have been introduced by Druyvesteyn (*16*). An excellent alternating current method of study of the energy distribution has been developed by Sloane and McGregor (*73*) in the laboratory of Emmeléus at Belfast.

Probably the greatest contribution to the fundamental analysis of electrical discharge mechanisms is due to the studies of Townsend (*81*) and his group, which began in 1899 to 1903 on the two ionization coefficients. Townsend observed that if one started a current of i_0 electrons from the cathode in a uniform field plane parallel gap of length x and placed a high field, X, at a pressure, p, across the gap, the current of electrons and ions, i, measured after the initial electrons had crossed the gap was given by $i = i_0e^{\alpha x}$. Here α is a constant dependent of the nature of the gas and the value of X/p. It gives the average number of new electrons produced per unit distance traversed in the field direction by one electron through ionization by collision of the gas atoms or molecules. Townsend further found that this quantity, α, now designated as the first Townsend coefficient, varied such that one could write $\alpha/P = f(X/p)$. The $f(X/p)$ is a complicated slanting S-shaped curve in which the *initial* rise was shown by Masch (*54*) in Aachen and Sanders (*68*) in Loeb's laboratory independently to be of the form $e^{BX/p}$, while the top of the curve has a form varying about as $(X/p)^{1/2}$, as shown by Posin (*64*). Although earlier evaluations suffer from deficient control of gaseous purity, the later results of Penning and Kruithoff (*39*) in Eindhoven on the inert gases and of Bowls (*6*) and Hale (*23*) in Loeb's laboratory for pure N_2 and H_2 probably begin to represent the proper values. The work of both Penning and Loeb's group demonstrates the effectiveness of the actions of certain impurities present to 1 part in 10^8 or 10^6. While earlier theoretical attempts to evaluate α before a proper appreciation of interaction between electrons and atoms or molecules was at hand are faulty, we now have a proper procedure outlined in the theory first suggested by Holm (*27*) but finally developed by Emmeléus, Lunt, and Meek (*18*). It cannot today be applied to calculations of α/p except in limited regions where the electrons have the Maxwellian energy distribution, in that it depends critically on the form of the distribution law. One can then rest assured that the pioneering work done by Townsend is basically correct and feel quite confident in the applications of the first function. Aside from the ignorance of the correct electron energy distribution, the information most urgently needed today by the engineer is a reliable set of experimentally determined values of α/p over large ranges of X/p in important gases of recognized purity. The need for such data is evident when it is noted that we have as yet no values for α/p in pure mercury-free air from X/p 20 to X/p 1,000, the region covering most discharge phenomena in air. Values in mercury-contaminated air may well be 25 per cent off at high values of X/p.

Townsend's second (*83*) great contribution in the study of discharges lay in the analysis of the curves for i at higher values of X/p, in air above X/p = 100, at which point i increases more rapidly than according to $i = i_0e^{\alpha x}$. This is seen at once by plotting $\log \frac{i}{i_0}$ against x. The resulting linear graphs, whose slope gives α, are replaced by lines that are initially straight but curve upward at higher values of x. This upcurving was ascribed by Townsend to the creation of β new electrons, by impact of *positive* ions on molecules, per unit distance of advance from anode to cathode. Both Townsend and Thomson (*76*) in about 1902 independently recognized, however, that the effect of this β mechanism could also be produced if each positive ion striking the cathode had a chance, γ, of liberating a new electron from the cathode.

While Townsend has for a long time adhered to his original assumption that positive ions can ionize in the gas, the extensive experimental data and theoretical study have shown that, with values of X/p existing in the gas, positive ions cannot ionize (*89*). Meanwhile it had been shown by Brode and Neumann (*10*) that other secondary mechanisms beside the electron liberation can be effective in producing the observed increase in the curves of Townsend. These mechanisms are photoelectric liberation at the cathode originally proposed by Taylor (*75*), Holst (*29*), and others, the action of metastable atoms on the cathode (*36*), and photoelectric action in the gas, which plays important roles in gaseous breakdown at higher pressure (*14*) but is probably of little significance under Townsend's experimental conditions. Aside from the quantity, β, then, at least three processes, electron liberation by positive ion bombardment, photoelectric liberation from the cathode, and, in appropriate gases, action of metastable atoms at the cathode, are known by experiment to give adequate numbers of electrons to yield a satisfactory process. It now happens that the extent of the curved portions of Townsend's curves are not adequate to enable one to differentiate the processes active, and Brode and Neumann in 1928 showed that within the limits of uncertainty each of these processes would yield an equation for i, with appropriate constants that would fit the observed curves. In consequence we will designate what Townsend originally called his coefficient β as the second Townsend coefficient without implying any specific mechanism. It is conventionally ascribed today to a liberation of electrons by positive ion impact on the cathode and designated by the Greek letter γ. The resulting current, i, for high values of X/p is thus given by $i = \frac{i_0 e^{\alpha x}}{1-\gamma e^{\alpha x}}$. If the other processes are active, equations of analogous form with appropriately altered constants can be used.

The essential validity of these conclusions is again indicated by the results obtained by Bowls and Hale in pure N_2 and H_2, using different cathode surfaces, once mercury contamination had been eliminated, as well as by the work of Huxford and Engstrom (*20*).

While the recent advances have clarified the situation and indicated the solution, the state of knowledge is woefully deficient, for in the interpretations of most discharge phenomena the values of these various secondary mechanisms are indispensable. The current needs in this direction will now be indicated.

While the beautiful studies of Oliphant (*62*), the 37th Kelvin lecturer, and others (*33*) on the secondary electron liberation by positive ion impact gave data for ions of higher velocities, nothing is known about the efficiency of different ions on various surfaces for ions below 20 volts of energy. Nor is the relation between the work function of the cathode and this liberation known. Such defects in knowledge extend as well to the liberation of electrons by metastable atoms. Likewise, while the work of Taylor and others has indicated the order of magnitude of the photoelectric yields from the cathode by photons produced in a Townsend gap, there is absolutely no proper quantitative data either on the actual yields for different metals under different conditions of gaseous content or on the changes in work functions of such surfaces with different gas coatings. There is also little information as to the efficiency of the various wave lengths in the ultraviolet below 1,000 A. either at surfaces or in gases, or of the absorption coefficients of such photons in the gases used.

Finally, we are in complete ignorance of the yield of photons accompanying the electron avalanches caused by Townsend's α in their passage to the anode at various electron energies in fields near those of breakdown. This deficiency is now more serious, since the photon production is essential for the streamer process which characterizes all breakdown at higher pressures and gap lengths. Hence, intensive study of photon production, absorption, and photoionization in standard gases constitutes one of the most urgent fields of investigation. It is believed that the postwar experimental techniques are probably now adequate for the tasks indicated above.

The original criterion for the breakdown of a plane parallel gap to yield a spark, which Townsend (*82*) took from the equation $i = \frac{i_0 e^{\alpha x}}{1-\gamma e^{\alpha x}}$ by setting $1 - \gamma e^{\alpha x} = 0$, has been substantiated in fact. It is now established that Townsend's use of the equation above for this purpose was unwarranted, but Holst (*29*) has indicated that the condition fixes the *threshold* for a spark breakdown on other considerations. This correct interpretation, as more recently indicated by Loeb (*49*), at once leads to an understanding of the statistical fluctuation in the values of the potential at which individual sparks appear and further correlates well with recent time-lag studies. Experimental confirmation of the Townsend-Holst mechansim for sparks at relatively low pressure and gap length has been achieved by the time-lag studies of Schade (*70*). As, however, Meek (*57*) has indicated in his excellent paper before the Institution, after 1927 many lines of evidence converged to show that the mechanism as pictured by Townsend and Schade for the plane parallel gaps at lower pressures cannot apply at pressures approaching atmospheric and gaps in excess of a few millimeters in length. The work of Loeb (*85*) and his students on positive corona, beginning in 1936, inevitably led to the development of the streamer theory of the spark by 1940. For this Meek (*56*) provided the quantitative criteria. Slightly later and from quite a different line of investigation using a C. T. R. Wilson Cloud Chamber, Raether (*65*) in Jena arrived at the streamer mechanism of breakdown and actually photographed the streamers. Quite independently of Meek, he arrived also at the same quantitative criterion, although he did not carry his investigations very far. The logical extensions of this new mechanism were carried as far as speculation and the war permitted by Meek and Loeb in their book (*51*) on the mechanism of the spark. This analysis leads to countless unanswered questions, and the problems awaiting solution are too many to mention. The famous Paschen law that the sparking potential is a function of the product of pressure and gap length is not obeyed by Meek's theory, and the recent measurements of Howell (*30*) indicate that the discrepancies are very large at higher pressures. There are no continuous, consistent sets of data on sparking potentials in mercury-free dry air with pressure varying and gap constant, and vice versa, over a sufficient range of pressure and gap length values to permit of a test of the theory. Such an investigation by one laboratory is urgently required but is an exceedingly laborious and perhaps costly undertaking, as high potentials and fairly long gaps free from electrical field distortion are needed. Another urgent study requires that the points of transition from the Townsend mechanism to the streamer mechansim at different pressures be determined. Present estimates range from a value of 200 mm. pressure × cm. gap length for a 1-cm. gap in air to 1,000 mm. × cm. Other problems involve the study of the streamer mechanism of breakdown which proceeds from a negative point, and the question of the sparking potential for very long gaps.

The use of the simultaneous application of all available methods of study as initiated by Loeb's (*50*) group and the development of new, fast oscillographs have led to notable advances in the understanding of the positive and negative corona mechanisms and their ultimate breakdown to a spark. Much still remains to be done, but progress appears to be satisfactory. The study of spark breakdown with alternating potentials, particularly as functions of frequency, has shown that the threshold is lowered some 17 per cent as frequency is increased from 10^4 to some 4×10^6 cycles in short gaps, doubtless owing to positive space charge accumulations (*67*). As frequencies go up to the radar range of 10^{10} to 3×10^{10} cycles, the potential rises some 25 per cent above the d-c breakdown. In this case the electrons travel only short distances between reversals of the field, and the whole mechanism is little understood. The investigation of the whole range of frequencies and a study of the mechanisms at work present a series of fascinating problems for an interested observer.

Considerable advance in the understanding of the vacuum spark, so important in modern industrial application, has resulted from Bennett's (*4*) theory of the self-focusing beam. This theory materially assisted the successful study of the mechanism of the vacuum switch by Koller (*37*) in Loeb's laboratory.

One or two comments are in order with respect to glow discharge and the arc. Thanks to the development of probe studies, more is known about the glow than any other form of gaseous discharge. Thus, wherever probe studies are possible, gradients, potentials, electron energies, and, thanks to Druyvesteyn (*16*) and Sloane and McGregor (*73*), their energy distributions can be measured. There are, however, two regions in which such methods are not too successful. These are the cathode dark space, where ionization is insufficient, and the region of the anode fall of potential. It is desirable that much more data be gathered concerning the anode fall where the electrons have high energies, a negative space charge sheath exists, and in which the positive ions are created. The vital element in any quantitative treatment of the glow discharge lies in a knowledge of the cathode fall of potential. Since probes fail in this region, only one proper survey has been made in one discharge type by the late F. W. Aston (*2*), using the deflection of a fine cathode-ray beam. It is urgent that further studies be carried out in other gases over a range of pressures. With modern improvements in techniques, such as electron multipliers and cathode-ray oscillographs, it is expected that more information can be obtained by electron beam measurements. Recent investigations by Morton (*60*) and later work by Johnson (*34*) in Loeb's laboratory have shown that in fields which vary as rapidly with distance as do the dark space fields, one cannot apply the first Townsend coefficient as measured in uniform fields for calculating the ionization produced. Not only is the ionization from 2 to 6 or more times greater than given by the integration of such coefficients over the cathode fall, but the spatial distribution of ionization about the cathode is just the inverse of that given by the use of Townsend's functions. This recent investigation explains the striking characteristic structure of dark space and glow always observed and previously at variance with theoretical prediction on Townsend's function Thus, past attempts at calculation of the glow discharge using the condition of Holst and Oosterhuis (*28*), Seeliger (*72*), and v. Engel and Steenbeck (*19*), that $\gamma e^{\int \alpha x} = 1$, must be modified by replacing $e^{\int \alpha dx}$ by the evaluations of G. W. Johnson for the conditions found by Morton. Johnson's work covers these functions for pure H_2 and mercury-free air from 0.1 to 760 mm. pressure. More data such as Johnson's on other standard gases are urgently needed, and the investigation should be extended to spherical electrode symmetry instead of cylindrical.

With regard to the mechanisms of arcs, the high temperatures and microscopic scales of distance involved in the critical areas preclude study, and much remains to be done. While the refractory electrode arcs are amenable to some measure of theoretical treatment, the mechanism of the low-melting-point metal vapor arc is not clearly understood and is not amenable to solution. There seems little doubt but that the source of ions in such arcs is in the plasma of the gas adjacent to the cathode and previous speculations such as those invoking field emission are inadequate to account for the phenomena. Equally illusory are the attempts to account for the mechanism by the glib term, "temperature ionization." Granted that the region near the cathode is at a high temperature, conditions are so far removed from equilibrium that one cannot apply M N. Saha's equation. It appears that we are confronted in this study with a situation presently also being encountered near the surface of particles moving with supersonic velocities, in which we cannot apply the familiar procedures of thermodynamics and kinetic theory. In these cases one has in microscopic regions large numbers of atoms or ions moving to the cathode or a surface, interchanging energy with solid or liquid surfaces, and leaving those surfaces with considerable directed momentum and energy. In these regions there are thus large numbers of particles of energy many times those of thermal equilibrium with directed velocities. The conditions for ionization are present, but a new mathematical physics is needed to calculate the consequences which depart widely from equilibrium conditions.

In presenting this summary I have attempted to include the advances and accomplishments in the last 50 years. What I consider more important, however, in this brief summary is not so much a glorification of the past but an indication of the problems still to be solved. It is my hope that the indications of just a few of these will arouse an interest in this presently neglected field, inspiring some few individuals, at least, to aid physicist and engineer in the work which remains to be done.

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The Truman Veto

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SCIENTISTS WILL UNDOUBTEDLY BE tempted to condemn the President for vetoing the National Science Foundation Act of 1947 (S. 526), and some have already yielded to this temptation. It may be hoped that the rest will apply the same processes of analytical thought to the reasons behind the veto as they conscientiously apply to their own professional problems.

Although the vetoed Smith bill has evolved a long way from the Magnuson bill, which was introduced into the 79th Congress during the summer of 1945, it is basically the same type of legislation. It has made some political concessions on patent provisions; it has prescribed a feeble measure of geographical distribution for scholarships; and it has liberalized the divisional structure of the Foundation. However, it strictly adheres to administration by a part-time board of eminent scientists, and it commits the legislative blunder of creating an Inter-Departmental Committee on Science whose chairman is an appointee of the part-time board, notwithstanding the fact that his powers affect many of the executive departments of the Government. For the President to have no say in naming a committee chairman who, in regard to scientific matters, outranks his own Cabinet officers in the executive branch of the Government is little short of preposterous. As originally drawn and finally passed, the bill still precludes reasonable geographic distribution of funds for research. It is, in short, the Bush bill, based upon the Bush report, *Science, the endless frontier*. It was, moreover, engineered through committee by the man who, in 1945 and 1946, personally represented Dr. Bush.

In 1946 the Administration made it perfectly clear that, if such a bill reached the President's desk, it would be vetoed, and the reasons given were substantially the same as those contained in the veto message. That the Administration's views were shared by many scientists and other educators was evident from the size and vigor of the committee formed by Harlow Shapley and Harold C. Urey. Furthermore, that the President had not changed his mind in 1947 must have been clear to Dr. Bush and the other supporters of the bill. It is reported that Senator Smith had even more authoritative information regarding the President's attitude.

In the face of the President's forthright statements, S. 526 was drafted and introduced. Little regard was paid to the carefully considered recommendations of the Inter-Society Committee, sponsored by the American Association for the Advancement of Science. The Morse Amendment, which liberalized the geographic distribution of research funds and which might possibly have saved the bill from veto, was defeated in the House. So the Bush bill went to the President, and the President kept his word. If the proponents found no reason to change the bill, certainly the President had no reason to change his mind. Indeed, it was virtually necessary to veto a piece of legislation which assigned powers in the executive branch of the Government to a director whom the President could neither name nor remove.

Scientists must look at facts squarely and honestly. There are many who favor S. 526 because they have faith in administration by scientists who have demonstrated ability in science and in administration. But there are as many more who feel that, however capable the administration of a scientific board may be, the Board is bound to consist of men who, from temperament and experience, will administer Government-supported scientific research in the same way as industrial and national defense research. At present fewer than 50 institutions are receiving well over 90 per cent of all research financing from industry and from the Army and Navy. There is no complaint about this allotment of funds, but there is serious objection to the disproportionate award of additional grants to the same institutions. Not only will it widen the gap between the large and the small universities and technical schools; it will literally dwarf the latter by drawing Foundation-subsidized students and underpaid but competent instructors to the former.

Two provisions of the bill make such a trend inevitable: (1) the qualifications set for members of the Board, who will necessarily be mainly big-name men from big-name institutions; and (2) the stipulation that research grants shall be made to the institutions best qualified to carry out the projects in question. Such a policy makes good sense to practical business-minded men, but its execution will serve to deepen the existing foundations of science rather than to broaden them or to build new ones.

The administrative structure of the Foundation as proposed in the vetoed bill would have concentrated too much power in the hands of too few, without a single effective control from scientists, the Congress, or the President. Let us grant that the choice of scientists would fall upon men in whom there is complete public and professional confidence. The full Board is required to assemble but once a year, and effective control rests with an executive committee of 9. Everyone will agree that the advice and guidance of such men is imperative to the success of a Foundation; yet, regardless of the character of the men who will be selected, and who will undoubtedly give sincere and disinterested service to the public and to science, is it wise to leave American scientists without recourse or appeal from the acts of the Foundation, save through the slow machinery of presidential appointment or through violent death by the withholding of appropriations?

Already Government-financed research and not a little industrial research are guided and, to some extent, controlled by a small group of scientists. Let it be said they have done their job well. But many scientists are as deeply concerned about close professional control as they are about the hazards of political control. If the Smith bill (S. 526) assures freedom from the latter, it certainly invites and almost prescribes professional control, which may quite conceivably be identified with the group directing so much industrial and military research. That there may be something to fear is suggested by the way in which S. 526 was introduced and maneuvered in Congress, the limited sources from which advice was sought, and the studied disregard of preferences expressed by the Inter-Society Committee, which had the broadest possible base among U. S. scientists.

There are those who sincerely believe that no such danger exists, but this belief is not held by many who were close to the situation in Washington. It certainly was not held by President Truman, who has persistently shown a genuine concern about the welfare of science. Is it not reasonable, now, to urge that those who have tried to get a particular type of legislation passed and have twice failed, relinquish the task to disinterested, scientists, who will view the problem more broadly and dispassionately? There are many such men, and there is no hostility toward science either in the Congress or in the White House. The Senate has, by passing S. 1850 in 1946 and S. 526 in 1947, demonstrated that it is trying to give scientists what they want. What it needs now is the advice of representatives of science rather than advocates of a partisan point of view. Surely the Association's Inter-Society Committee comes closer to the requirements of the present situation than a group determined to give science what is supposedly good for it, whether it wants it or not. This is the time for leaders in the Inter-Society Committee to take over and to act.

NEWS *and Notes*

Since many scientists will not have seen the complete text of President Truman's Memorandum of Disapproval of S. 526, dated August 6, and since many others will undoubtedly wish to refer to it in the coming months, the veto message is presented in full below:

I am withholding my approval of S. 526, the National Science Foundation Bill.

I take this action with deep regret. On several occasions, I have urged the Congress to enact legislation to establish a National Science Foundation. Our national security and welfare require that we give direct support to basic scientific research and take steps to increase the number of trained scientists. I had hoped earnestly that the Congress would enact a bill to establish a suitable agency to stimulate and correlate the activities of the Government directed toward these ends.

However, this bill contains provisions which represent such a marked departure from sound principles for the administration of public affairs that I cannot give it my approval. It would, in effect, vest the determination of vital national policies, the expenditure of large public funds, and the administration of important governmental functions in a group of individuals who would be essentially private citizens. The proposed National Science Foundation would be divorced from control by the people to an extent that implies a distinct lack of faith in democratic processes.

Moreover, the organization prescribed in the bill is so complex and unwieldy that there is grave danger that it would impede rather than promote the Government's efforts to encourage scientific research. The Government's expenditures for scientific research and development activities currently amount to hundreds of millions of dollars a year. Under present world conditions this work is vital to our national welfare and security. We cannot afford to jeopardize it by imposing upon it an organization so likely to prove unworkable.

Under S. 526, the powers of the proposed Foundation would be vested in 24 members appointed by the President by and with the advice and consent of the Senate. These members would be part-time officials, required to meet only once each year. This group would, in turn, select biennially from among its 24 members an executive committee of 9 members and would exercise its powers through the executive committee. This 9-member executive committee would also be a part-time body required to meet only 6 times a year.

The Foundation would have a chief executive officer, known as the Director.

He would be appointed by the 9-member executive committee unless the 24-member body itself chose to appoint him. The power and duties of the Director would be prescribed by the executive committee and exercised under its supervision.

There would be within the Foundation a number of divisions, each exercising such duties and performing such functions as the Foundation prescribed. There would be no limit upon the number of divisions which the Foundation could establish. For each division there would be a divisional committee. In the case of the Committee for the Division of National Defense there would be a limit of 36 members, half of whom would be appointed by the Foundation and half of whom would be representatives of the armed services. In other cases, there would be no limit upon the number of members of each divisional committee and all of the members would be appointed by the Foundation. Not only would these part-time committees furnish advice and make recommendations concerning the Government's scientific research program, but each divisional committee would also "exercise and perform the powers and duties of its division."

The Foundation would also be empowered to appoint commissions in various fields of research. Three such commissions are specified in the bill, and the Foundation could appoint as many additional special commissions as it saw fit. Each such commission would consist of 6 eminent scientists and 5 members from the general public. After making a survey of public and private research already being carried on, each of these commissions would recommend a research program within its field and constantly review the manner in which such a program was being carried out.

Apart from the conflicts and confusion which would result from this complex organization, the bill would violate basic principles which make for responsible government.

The Constitution places upon the President the responsibility for seeing that the laws are faithfully executed. In the administration of this law, however, he would be deprived of effective means for discharging his constitutional responsibility.

Full governmental authority and responsibility would be placed in 24 part-time officers whom the President could not effectively hold responsible for proper administration. Neither could the Director be held responsible by the President, for he would be the appointee of the Foundation and would be insulated from the President by two layers of part-time boards. In the case of the divisions and special commissions, the lack of accountability would be even more aggravated.

The members of the Foundation would also be authorized to appoint the full-time administrative head of an important agency in the executive branch of the Government, as well as more than 70 additional part-time officials in whom important governmental powers would be vested. This represents a substantial denial of the President's appointing power, as well as an impairment of his ability to see that the laws are faithfully executed.

The ability of the President to meet his constitutional responsibility would be further impaired by the provisions of the bill which would establish an Interdepartmental Committee on Science. The members of this committee would be representatives of departments and agencies who are responsible to the President, but its chairman would be the Director of the Foundation. It would be the duty of this committee to correlate data on all Federal scientific research activities and to make recommendations to the President, to the Foundation, and to the other departments and agencies of the Government concerning the performance of their functions in this field. Thus, an officer who is not appointed by the President, and not responsible to him, would be the man primarily charged with the performance of functions which are peculiarly within the scope of the President's duties—that is, the coordination of the work of executive agencies. This is especially unwise when the activities concerned are so intimately related to the national welfare and security.

There are other compelling reasons why control over the administration of this law should not be vested in the part-time members of the Foundation. The Foundation would make grants of Federal funds to support scientific research. The recipients of these grants would be determined in the discretion of the Foundation. The qualifications prescribed in the bill for members of the Foundation would insure that most of them would be individuals employed by institutions or organizations eligible for the grants. Thus, there is created a conflict of interests which would inevitably give rise to suspicions of favoritism, regardless of the complete integrity of the members of the Foundation.

It is unfair to individuals asked to accept public office that they should be put in such a vulnerable position. Moreover, colleges and universities and other organizations seeking aid for scientific research deserve the assurance that the manner and extent of their participation in a national program will be determined on a completely impartial and objective basis.

Adherence to the principle that responsibility for the administration of the law should be vested in full-time officers who can be held accountable will not prevent the Government from utilizing with great advantage the services of eminent scientists who are available only for part-time duty. We have ample evidence of the patriotic and unselfish contributions which such citizens can make to the success of governmental programs. The role to be played by such part-time participation, however, is more appropriately one of an advisory nature rather than of full responsibility. In other governmental programs of vast national importance, this method is used to obtain advice and recommendations from impartial experts as well as from parties in interest. There is no reason why such a system cannot be incorporated in legislation establishing a National Science Foundation.

For the reasons I have indicated, I believe that this bill raises basic issues of public policy. There would be no means for insuring responsible administration of the law. If the principles of this bill were extended throughout the Government, the result would be utter chaos. There is no justification in this case for not using sound principles for normal governmental operations. I cannot agree that our traditional, democratic form of government is incapable of properly administering a program for encouraging scientific research and education.

It is unfortunate that this legislation cannot be approved in its present form. The withholding of my signature at this time, however, will not prevent the Government from engaging in the support of scientific research. Research activities are carried on extensively by various executive agencies under existing laws, and would continue to be carried on whether or not this bill became law. The only funds made available by the Congress for expenditure by the Foundation are funds which might be transferred from other agencies, thereby reducing the amounts which those other agencies could spend for similar purposes. No funds were made available for the scholarships and fellowships authorized in the bill. Thus, there would be no immediate gains which would justify accepting the risks involved in the approval of this legislation.

I am convinced that the long-range interests of scientific research and education will be best served by continuing our efforts to obtain a Science Foundation free from the vital defects of this bill. These defects in the structure of the proposed Foundation are so fundamental that it would not be practicable to permit its establishment in this form with the hope that the defects might be corrected at a later date. We must start with a law which is basically sound.

I hope that the Congress will reconsider this question and enact such a law early in its next session.

About People

Dorwin Cartwright has been named director of the Research Center for Group Dynamics, Massachusetts Institute of Technology, succeeding the late **Kurt Lewin**.

Kenneth E. Caster, on leave from the University of Cincinnati for the past two years while serving as director, Department of Geology and Paleontology, University of São Paulo, Brazil, in connection with the State Department's program of cultural cooperation, will terminate his work there at the end of this year. He will remain in South America until September 1948, however, in order to complete geological studies supported by a Guggenheim Fellowship. Upon his return to Cincinnati the Brazilian paleontologists, **Josué Camargo Mendes** and **Setembrino Petri**, will assist in the preparation of stratigraphic and paleontologic reports covering some 50,000 kilometers of Brazilian travels.

Rafael Rodríguez-Molina, recently discharged from the Medical Corps, U.S.A., with the rank of Lt. Colonel, has been appointed chief of the Medical Service, Veterans Administration Center, San Patricio Hospital, San Juan, Puerto Rico. Dr. Rodríguez-Molina was formerly assistant professor of tropical medicine, University of Puerto Rico and Columbia University.

Gordon H. Pritham, head, Department of Chemistry, University of Scranton, has been named associate professor of physiological chemistry, Department of Agricultural and Biological Chemistry, Pennsylvania State College, and **Eva Ruth Hartzler**, associate nutritionist, University of Hawaii, has accepted a position in vitamin research in the same Department.

Arthur C. Bevan, state geologist of Virginia, Charlottesville, and chairman, Division of Geology and Geography, National Research Council, has been appointed principal geologist in charge of the Geological Resources Section, Illinois Geological Survey, Urbana. Dr. Bevan succeeds **Ralph E. Grim**, who will devote more time to the Survey's research program on clay minerals.

T. G. Blocker, Jr., professor of plastic and maxillofacial surgery, has been appointed director, Post-Graduate Training Program, University of Texas Medical Branch, Galveston.

W. N. Bangham, formerly director, Plant Research Department, Goodyear Rubber Plantation Company, Costa Rica, has been appointed editor of *La Hacienda*, a Spanish journal covering agricultural and allied industrial subjects, with offices at 20 Vesey Street, New York City.

Richard B. Goldschmidt, of the University of California, has returned from New Zealand and Australia, where he has been for the past 6 months. In New Zealand he delivered a large number of lectures under the auspices of the Royal Society, the University of New Zealand, and the Council of Scientific and Industrial Research in all universities and agricultural colleges of the Dominion. In Australia he gave a series of lectures at Sydney University and the Department of Scientific Research in Canberra.

Warren Andrew, professor of histology and embryology, Southwestern Medical College, Dallas, has been appointed professor of anatomy and chairman of the Department, George Washington Medical School, Washington, D.C.

John T. Buchholz, professor of botany, University of Illinois, has been granted a year's leave of absence to collect gymnosperms and other plants in New Caledonia. He will also visit the Fiji Islands, Tasmania, and Australia. Dr. Buchholz may be reached % Biological Station, Noumea, New Caledonia.

John H. Weitz, Pennsylvania Topographic and Geologic Survey, has been appointed assistant professor of geology, Lehigh University.

Emanuel D. Friedman, chairman, Department of Neurology, New York University College of Medicine since 1927, retired September 1 as professor emeritus. Dr. Friedman has been on the College of Medicine staff for 37 years.

Oswald Tippo has been named acting head of the Department of Botany, University of Illinois, succeeding **Neil E. Stevens**, who transferred to the Department of Horticulture, College of Agriculture, on September 1.

Grants and Awards

The Biological Stain Commission has made two grants for research on stains and staining methods: (1) $1,500 (renewal) to Northwestern University Medical School for research in methods of neurological microtechnic under the direction of H. A. Davenport; and (2) $1,800 to McGill University for work in cytochemistry under the direction of C. P. Leblond. The latter work will deal with the Feulgen reaction and the significance of cytological structures giving that reaction.

George C. Supplee, president, G. C. Supplee Research Corporation, Bainbridge, New York, will be the recipient of the 1947 Borden Company prize of $1,000 and a gold medal for research in the chemistry of milk to be presented September 15 at the 112th national meeting of the American Chemical Society in New York. Dr. Supplee, who is credited with developing the first practical methods for commercial irradiation of milk to increase its vitamin D content, will deliver his award address September 18 at a symposium on the biochemistry of milk.

The American Allergy Fund has announced the availability of grants-in-aid for research which will be made to investigators in the biological sciences, both medical and nonmedical, whose problems meet the requirements of the Scientific Advisory Council. Preference will be given problems with immediate relationship to allergy, although investigations in physiology, biochemistry, pharmacology, immunology, genetics, and other basic sciences are solicited. The grants will be made for one year in amounts not to exceed $3,500 and may be renewed from year to year if continuation is warranted. Applications (7 copies) should be addressed to the American Allergy Fund, 525 Erie Building, Cleveland 15, Ohio, Attention: Scientific Council, and should contain the following information: a statement of specific research problems and an outline of the method or methods of procedure to be followed; a description of research facilities in the institution where investigator will employ the grant; a tentative budget; and a statement of the applicant's research record, accompanied, if possible, by publications or reprints.

The American Allergy Fund, organized a little more than a year ago, has a five-point program embracing the following aims: to finance research in basic sciences; to keep physicians informed of the latest developments in allergy; to encourage medical students in the study of allergy; to promote public education in allergy; and to help provide care for needy allergic children and adults. Jonathan Forman, editor, *Ohio State Medical Journal*, is president of the Board, and Anton J. Carlson, University of Chicago, is chairman of the Scientific Advisory Council.

Colleges and Universities

A Department of Statistics has been established within the Division of Science, Iowa State College. **Raymond J. Jessen,** resident collaborator, Bureau of Agricultural Economics at the College, will be acting head of the new Department and also of the Statistical Laboratory.

The effect on animals and humans of changes from one altitude to another has been studied this summer by members of the Zoology Department, University of Chicago, under the direction of Carl R. Moore, chairman of the Department. These experiments, conducted with four separate animal colonies maintained in the zoology building at the University of Chicago (600 feet), at Idaho Springs, Colorado (7,500 feet), at the summer geological and biological field station of the University of Colorado (9,600 feet), and in the cosmic ray laboratory on the crest of Mt. Evans (14,260 feet), were suggested by earlier work by Carlos Munge, of the University of Peru, who was interested in the problem of altitude sickness in humans and that of sterility induced in certain breeds of sheep imported from low altitudes to pastures above 12,000 feet in the Andes. The results of the experiments should be of interest not only to scientists but also to mountain travelers, pilots, and stock raisers.

Reed College has announced the inauguration of a new course entitled "The Development of the Experimental Sciences," to be given during the fall and spring semesters of 1947–48. The course is described as "an inquiry into the history of the sciences in relation to society and a study of the methods of science in gaining and applying new knowledge." It has been organized by Frank H. Hurley, associate professor of natural science, and is based on a similar, but less extensive course first given during the summer of 1944. The new course is offered at the junior level and is open to all students who have had one or more years of study in the laboratory sciences.

Meetings

An International Conference on the Earth Sciences and Civilization will be held September 21–23 at South Duxbury, Massachusetts, under the auspices of the Commission on Continental and Oceanic Structure, and the Committee on the Social Value of the Earth Sciences, International Union of Geodesy and Geophysics. Members of the latter organization or of the American Geophysical Union who wish to attend should notify R. M. Field, South Duxbury, or J. A. Fleming, 1530 P Street, N. W., Washington, D. C.

The 8th Pittsburgh Conference on Applied Spectroscopy, sponsored by the Spectroscopy Society and the University of Pittsburgh, will be held in the Mellon Institute Auditorium, November 13–15. Sessions on both emission and absorption spectroscopy are planned. Those desiring to submit papers for the Conference should send in the title and a brief abstract by October 4. Inquiries or offers of papers should be addressed to Mary E. Warga, University of Pittsburgh, Pittsburgh 13, Pennsylvania.

The American Academy of Dental Medicine will hold a luncheon meeting prior to the Greater New York Dental Meeting at Hotel Pennsylvania, Sunday, December 7, at 12:30 P.M. A round-table discussion will follow. All members and interested dentists and physicians are invited to attend. Communications should be addressed to Dr. William M. Greenhut, secretary, 124 East 84th Street, New York City.

Recent Deaths

George Matthai, of the Zoological Laboratory, Cambridge University, and an authority on corals, was found dead June 25.

Alexander W. Winkler, 38, assistant professor of internal medicine, Yale University, died June 26 in New Haven Hospital.

Elliott Carr Cutler, 59, Moseley professor of surgery, Harvard University, and surgeon-in-chief, Peter Bent Brigham Hospital, Boston, died August 16 at his home in Brookline, Massachusetts. Dr. Cutler was known for his work in heart and thyroid surgery.

Ernst Laqueur, 68, professor of pharmacology, University of Amsterdam, Holland, who first isolated testosterone in 1935, died August 19 while vacationing in Switzerland. In 1946 Dr. Laqueur rereceived the Berzelius Medal, awarded by the Swedish Medical Society.

Cullen Warner Parmelee, 73, professor emeritus of ceramics engineering, University of Illinois, died August 20 at his summer home at Pilgrim, Michigan.

Sir Clive Forster-Cooper, 67, director, British Museum of Natural History, died August 23.

James T. Saldana, 64, professor of physics, St. John's University, Brooklyn, for 27 years, died August 23 after a long illness.

Clark Wissler, 76, curator emeritus, Department of Anthropology, American Museum of Natural History, died August 24 after a brief illness. Dr. Wissler had served on the Museum staff since 1902.

Just 13 months after receiving the first shipment of a pile-produced isotope from the Clinton laboratories, E. V. Cowdry, of the Barnard Free Skin and Cancer Hospital, St. Louis, had the privilege of announcing to the delegates assembled for the Fourth International Cancer Congress in St. Louis the Government's decision to embark on a program of distribution of radioactive isotopes to foreign research centers and hospitals. The items listed as available are restricted to the following: antimony 122, 124, 125; argon 37; arsenic 76, 77; bromine 82; calcium 45; carbon 14; chlorine 36; cobalt 60; copper 64; gold 198, 199; iodine 131; iron 55, 59; mercury 197, 203, 205; phosphorus 32; potassium 42; silver 108, 110, 111; strontium 89, sulfur 35; sodium 24; and zinc 65, 69. Conditions under which foreign shipments may be made include approval by the Commission prior to shipment in the manner followed with domestic requests; the making of progress reports every 6 months; and the opening of laboratories in which the isotopes are used to qualified scientists irrespective of nationality.

The total destruction of the archives and library of the Experimental Station for Sugar Cane at Pasuruan, East Java, by order of the Indonesian Republican authorities has been reported by the Government Botanic Gardens, Buitenzorg, Java, to Frans Verdoorn, editor of *Chronica Botanica*. This planned destruction of detailed data on hybrid cane species, plant diseases and resistant strains, test plantings, soil conservation, and irrigation is an immeasurable loss to the science of sugar cane cultivation and processing in general and to the Java sugar industry in particular.

Make Plans for—

American Chemical Society, September 15–19, New York City.

Clinical Conference on Diagnosis and Treatment of Poliomyelitis, September 15–17, Warm Springs, Georgia.

American Geophysical Union, 21st Regional Meeting, September 17–20, Wesleyan University, Woods Hole Oceanographic Institution, and Harvard University.

American Institute of Electrical Engineers, Middle Eastern District Meeting, September 23–25, Dayton, Ohio.

Oregon Geography Council, fall conference, October 4, Oregon State College, Corvallis.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS

by Readers

We wish to register a protest against two recent articles by Representative J. Parnell Thomas of New Jersey, chairman of the Congressional Committee on Un-American Activities. These are: "Russia Grabs Our Inventions" (*American Magazine*, June) and "Reds in Our Atom Plants" (*Liberty*, June 21).

Mr. Thomas' articles are inaccurate to the point of absurdity. Thus, in one, he says that the National Bureau of Standards tests patents, which will be news to the Bureau and the Patent Office. Nevertheless, his attacks on the patriotism and honesty of American scientists are bound to be taken seriously by many people and will do harm.

We are particularly aroused at the treatment accorded Dr. Edward U. Condon, director of the Bureau of Standards, who, by inference and innuendo, is made to appear engaged in reprehensible and subversive activities.

Dr. Condon is a distinguished scientist, the director of a great national institution, a former president of the American Physical Society, sometime adviser to the Senate on matters concerning atomic energy, and a former associate director of the Westinghouse Laboratories. By no stretch of the imagination is he a Communist or an unloyal American.

Mr. Thomas especially attacks Dr. Condon for his membership on the board of directors of the American-Soviet Science Society. This organization, which has received a grant from the Rockefeller Foundation, is in no way connected with any pro-Soviet agency. It exists solely for the purpose of furthering international exchange of scientific information (something scientists everywhere favor), particularly by making Russian scientific papers available in English.

Mr. Thomas furthermore plainly implies that Dr. Condon is dodging testifying before the Thomas Committee. Dr. Condon, however, can hardly be an unwilling witness, since he has never been invited to testify, although he was visited in March by two of the Committee's investigators, with whom he cooperated completely.

Mr. Thomas owes Dr. Condon and the Nation a retraction and an apology for his innuendoes concerning a distinguished scientist. (Irving Langmuir, D. A. MacInnes, George B. Pegram, I. I. Rabi, W. M. Stanley, and Harold C. Urey.)

Bacteriostasis is an important phase in the recent development of chemotherapy, and the quest for new natural and synthetic agents will, no doubt, pursue its course (H. W. Florey. *Brit. med. Bull.*, 1946, **4**, 248; V. C. Barry. *Nature, Lond.*, 1946, **158**, 863). The factors underlying bacterial inhibition extend, however, beyond the interaction of some specific substances with normal metabolic products of certain bacteria. Thus, in the absence of regulated administration, the bacteriostatic treatment itself may evoke in bacteria an environmental adaptation or an acquired resistance, as manifested by functional (p-aminobenzoic acid, enzymes) and structural (genes, chromosomes) changes (F. R. Selbie. *Brit. med. Bull.*, 1946, **4**, 267).

Again, the physical aspect of this problem is not without consequence. The fatty covering of some bacteria, as in the case of *tubercle bacilli*, may prevent contact between the organism and the agent, which is essential to bacteriostasis. These protective coverings could probably be removed and interaction made possible by the addition of a suitable solvent, such as acetamide, to the solution or colloidal suspension of the agent. Acetamide has a high solvent power, and both it and its hydrolytic products are nontoxic. Furthermore, its constitutional affinity to antibacterial substances, such as allantoin, urea (M. Copisarow. *Chem. Ind.*, 1942, **61**, 67), and sulfonamide, suggests the possibility of its synergic action in bacteriostasis. This may ultimately lead to the reassessment of the effective range of the bacteriostatic agents. (Maurice Copisarow, *1 Gildridge Road, Manchester, England*.)

TECHNICAL PAPERS

One Unconsidered Form of the Part Played by the Nervous System in the Development of Disease

S. I. Frankstein

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It is readily observed that, in walking, flexure of one of the anterior limbs of an animal is accompanied by a simultaneous flexure of the crossed posterior limb; at the same time both remaining limbs are extended and serve as a support to the body. In man, similar relations between upper and lower limbs are maintained in the form of additional movements of hands in walking.

It is known that these movements are made automatically, *i.e.* unconsciously. This is easily shown by removal of an animal's brain using the method of the prominent English physiologist, Sherrington, *i.e.* at the level between the anterior and posterior corpora quadrigemina. Such an animal cannot move independently. Its legs are extended like sticks and are in a state of a sharply marked extensor stress. The flexor response of one of the anterior limbs, produced by electrical or mechanical stimulation, is followed by a simultaneous relaxation in the crossed posterior limb like that observed in normal walking. In the remaining limbs the stress is increased. Marie et Foix showed that these regularities, stated by Sherrington, may also be revealed in men in cases of affection of the nervous system.

We studied the reaction of the limbs to the inflammatory process in animals (cats) decerebrated according to Sherrington's method. The process was evoked by subcutaneous injection of turpentine into the foot. It was found that under the action of the inflammatory process the extensor stress of the limb of the decerebrated animal disappears, and it becomes flaccid. If the inflammatory process spreads not only upon the foot but also upon the leg and thigh, the limb remains flaccid. If the inflammation is localized, instead of an extensor stress there is soon developed a stress in the flexor muscles—the leg is in the flexor posture.

It is curious that inflammation of the limb, as well as its electrical and mechanical stimulation, is followed by a change of the stress in the remaining unaffected limbs. Still more important is the fact that if the inflammatory process evoked in the animal before decerebration was already healed and the animal moved normally, decerebration made soon after healing produced changes of stress in the limbs similar to those observed in cases where the process of inflammation was at its height. The obtained evidence enables us to draw a series of conclusions which are so much the more important because inflammation is one of the most frequent reactions of the tissues of the organism to various injuries, and it is by inflammation that the overwhelming majority of affections is manifested.

(1) Inflammation different from mechanical or electrical stimulation causes *prolonged and persistent* excitation in the nervous system. Instead of the transient changes of stress in the legs of decerebrated animals which is caused by electrical or mechanical stimulation, a persistent change of the tonus is observed. Traces of this excitation may be detected in the nervous system also, some time after healing of the process at the periphery.

This prolonged stimulation produced by the inflammatory focus explains the fact that *the affected limb may maintain an unusual posture for a long time.* While interpreting this reaction in a wide sense as a psychologically comprehensible tendency to take care of the injured organ, we do not pay attention to the fact that in a healthy state it is impossible to maintain the organ in a forced position for a long time—the sense of fatigue comes very soon.

The automatic character of this reaction is also evidenced by the fact that it occurs in decerebrated animals as well.

(2) Stimulation produced by the inflammatory process as well as electrical or mechanical stimulations causes reaction not only in the injured limb but also in other concomitant limbs.

In the normal, uninjured nervous system this additional part of reaction remains latent, being compensated by the nervous system. This has not been taken into consideration by the modern pathology. Meanwhile, the "restricted," "local" character of pathological reactions is the result of the enormous work of the organism in concealing additional nonmanifested components of the reaction. Without such a compensation, *inflammation in the hand should unavoidably result in limping.*

(3) The organism is forced to compensate, to conceal also *the traces* of excitation left by the inflammatory process in the nervous system. As shown above, decerebration of the animal performed soon after healing of the pathological process disturbs this compensation, and, in spite of the healing of the injury, the leg takes the posture which earlier had been due to inflammation. Thus, the recovery of the animal, the restoring of normal function of the injured limb, is determined not only by *healing of the tissue injury*, as is assumed now in general pathology, but also by *compensation of traces of the pathological excitation in the nervous system.*

Thus, the above data reveal a new form of participation of the nervous system in the pathological process as well as in the process of recovery. A number of particular conclusions drawn from these experiments concerning alterations of the predilection type of the posture of limbs in central paralysis and the mechanism of reflex and fixation contractions are reported in another paper.

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Experimental Studies With the Agent of the Common Cold

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Nasal washings were collected from several cases of common cold infection within 24 hours after the onset of symptoms. The diluent was 2 per cent normal rabbit serum in physiological saline. Each of three such specimens was treated with penicillin sodium (30,000 units for 5 minutes) and then inoculated into the chorioallantoic cavity of 7-day-old incubating chick embryos (0.50 cc./egg). The inoculated embryos were further incubated at 35° C. At 4-day intervals the chorioallantoic fluid was collected from these eggs and pooled from each strain passage. Each strain was passaged blindly at 4-day intervals. Infectivity of the chorioallantoic fluid was checked periodically by inoculating this material into human volunteers[1] by the intranasal route. At no time could visible organisms be cultivated from this material when inoculated into synthetic medium. The results obtained from these three strains were as follows:

Strain I (Haltmar) was negative when chorioallantoic fluid of the second passage was inoculated into two volunteers.

TABLE 1

INTRANASAL INOCULATION OF HUMAN VOLUNTEERS WITH CHICK EMBRYO PROPAGATED COLD AGENT

No	Inoculum	Hours	Symptoms					
			"Stuffy"	Sneezing	Swollen mucosa	Exudate	Headache	Cough
11	MP strain, 2nd passage	24	−	−	+	−	−	−
		48	++	−	++	++MP*	++	−
		72	+++	−	++	++S*	−	−
		96	−	−	−	++P*	−	−
14	"	24	−	−	−	+S	−	−
		48	−	"sniffles"	++	++M	−	−
		72	+++	−	++	++S	−	−
		96	−	−	−	++MP*	−	−
18	MP strain, 3rd passage	24	−	−	−	−	−	−
		48	−	−	−	−	−	−
		72	−	−	−	−	−	−
19	"	24	+	−	+	+S	−	−
		48	−	−	−	−	−	−
		72	−	−	−	−	−	−

* S = serous exudate; M = mucoid exudate; MP = mucopurulent exudate; P = purulent exudate.

Strain II (MP) was infectious for two passages, but very mild or no reactions were induced with the third and later passages when it was inoculated into human volunteers (Table 1).

Strain III (Spill) was able to induce symptoms of the common cold after 9, 11, and 12 series of consecutive passages in the developing chick embryo (Table 2). It should be noted that the later passages of this agent induced much milder symptoms in the inoculated individuals than did the earlier. This might be due, of course, either to a difference in susceptibility of the individuals who were inoculated or to an attenuation of the agent by passage through a series of chick embryos. The clinical diagnosis of cold infection in the human volunteers was based on the development of a congested and swollen nasal mucous membrane, serous exudate, and sneezing. They manifested a feeling of stuffiness in the paranasal sinus areas and of mild malaise. There was no fever and no impairment

TABLE 2

INTRANASAL INOCULATION OF HUMAN VOLUNTEERS WITH CHICK EMBRYO PROPAGATED COLD AGENT

No.	Inoculum	Hours	Symptoms						
			"Stuffy"	Sneezing	Swollen mucosa	Exudate	Headache	Cough	Exercise tolerance
24	Spill strain, 9th passage	24	−	−	−	−	−	−	
		48	+++	−	+++	+S*	−	+	
		72	+++	−	+++	+S	−	+	
25	"	24	+++	Sniffing	+	−	−	−	
		48	+++	−	+++red	+S	−	−	
		72	+	−	red	−	−	+	
26	"	24	−+++	−	+++	−	−	−	
		48	+++	+++	+++	++S	−	−	
		72	++	−	+++	+++MP	−	+	
27	"	24	+++	+++	+++red	++M	−	−	
		48	+++	+++	+++	++MP	−	−	
		72	+++	−	++		−	−	
28	"	24	−	−	−	−	−	−	
		48	++	−	Injected	−	+−	−	Good
		72	−	−	−	−	−	−	Good
29	"	24	+	−	−	−	−	−	
		48	++	−	+++Injected	+M	−	−	Poor
		72	−	+	−	−	−	−	Good
30	Spill strain, 11th passage	24	−	−	+	−	−	−	
		48	−	−	−	−	−	−	
		72	−	−	−	−	−	−	
31	"	24	++	Sniffling	+Injected	−	−	−	
		48	−	−	−	−	−	−	
		72	−	−	−	−	−	−	
32	Spill strain, 12th passage	24	++	−	−	−	−	−	
		48	−	−	−	−	−	−	
		72	−	−	−	−	−	−	
35	"	24	−	−	−	+M	−	−	
		48	+++	−	++	Clearing throat	−	−	
		72	−	−	−	−	−	−	
39	Haltmar strain 2nd passage	24	−	−	−	−	−	−	Good
		48	−	−	−	−	−	−	
		72	−	−	−	−	−	−	
40	"	24	+++	−	++Injected	++S	+	+	Fair
		48	−	−	−	−	−	−	
		72	−		−	−	−	−	

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[1] We wish to express our appreciation to the staff and inmates of the Sugarland State Farm for their aid and cooperation in this study.

of appetite. The diagnosis was further based on negative hematological changes and negative Hirst tests for influenza A and B.

Six human volunteers were inoculated intranasally with chorioallantoic fluid (Spill strain) of the 9th passage in chick embryos. Five developed symptoms of cold, ranging from severe reactions to transitory, aborted manifestations. Five of these men and five new volunteers were inoculated subcutaneously with two doses of infectious chorioallantoic fluid (Spill strain), 1 cc. at weekly intervals. One week following the second inoculation, they were challenged intranasally with Seitz filtrates of nasal washings from naturally acquired cases of common cold infection. All of the individuals who had been immunized with the chick embryo propagated Spill strain cold agent failed to develop symptoms of cold; and with the same challenge inoculum, the two controls who had not been exposed to the Spill strain cold agent both developed marked symptoms (Table 3).

TABLE 3

Challenge Inoculation of Immunized Human Volunteers (1cc/week/2 weeks)

No.	Intranasal challenge nasal washings (pool of Connoly, Fly & Thompson)	Hours	Symptoms						
			"Stuffy"	Sneezing	Swollen mucosa	Exudate	Headache	Cough	Exercise tolerance
24	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
28	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
29	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
30	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
31	1.0 cc	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
41	Uninoculated control, 1.0 cc.	24	+++	Sniffling	++	++S	"Head tight"	+	Poor
		48	++	+	–	–	–	–	
		72	–	–	–	–	–	–	
32	Pool of Quattlebaum & Jones, 1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
33	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
34	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
35	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
36	1.0 cc.	24	–	–	–	–	–	–	
		48	–	–	–	–	–	–	
		72	–	–	–	–	–	–	
38*	Uninoculated control, 1.0 cc.	24	++	–	++	+++S	–	+	Fair
		48	++++	–	+++red	+++S	–	–	Poor
		72	+	–	++red	-	-	–	Poor

* This case developed an otitis media and ruptured ear drum 3 days later.

Six control volunteers were inoculated intranasally with normal chorioallantoic fluid from 11-day-old incubating chick embryos, and none developed any of the symptoms of cold infection. The same was true of five control volunteers inoculated intranasally with 2 per cent rabbit serum in physiological saline.

Development of Castes in Higher Termites

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Studies on the determination of castes (*5*, *6*) have been confined to the lower families of termites. The higher termites, the Termitidae, seem to offer more favorable opportunities to study the mechanisms which determine the development of the structurally very different castes. They possess a readily distinguishable worker caste, and the colony consists largely of fully differentiated terminal individuals, workers, and soldiers.

The nymphs of the lower families have been shown to be indifferent up to relatively late instars (*5*). Our findings reported here agree with those of Bathellier (*1*) in placing determination of castes in the Termitidae very early in nymphal development.

The lower termites are amenable to laboratory culture, but the literature shows no records of attempts to culture the higher termites except the method for mass culturing of the sterile castes of *Nasutitermes* (=*Entermes*) *exitiosus* Hill, worked out by Holdaway, Day, etc. in Canberra, Australia. A brief report of certain features of the method was presented in 1936 (*4*) by Holdaway and again in 1938 by Day (*2*).

Although the Termitidae are largely tropical, three genera are common in the southwestern United States: *Amitermes*, of which the most common species is *A. wheeleri* (Desneux); *Gnathamitermes*, with the common and widespread species *G. perplexus* Banks; and *Tenuirostritermes*, the most common species of which is *T. tenuirostris* (Desneux). *Tenuirostritermes* is a nasute termite in which the soldiers have only vestiges of mandibles and a long, pointed projection of the head on which opens the cephalic gland.

The writers devoted the spring and summer of 1946 to studies of the last two species in southeastern Arizona, where both are abundant. Using a method reported elsewhere (*7*), we have found that the incipient colonies can readily be cultivated beyond the point necessary to obtain experimental results. Groups from older colonies present greater difficulties, *Gnathamitermes* being less difficult than *Tenuirostritermes*. More detailed reports of field observations and experimental results will be presented elsewhere.

In these Termitidae, living under essentially temperate conditions, reproduction and caste development were found to be restricted to the warmer months.

In March the only immature individuals in the colonies of *Tenuirostritermes* were the large brachypterous nymphs (with rudimentary wings), destined to become the alates which swarmed in July with the summer rains. The colony consisted almost entirely, therefore, of terminal sterile individuals, the workers, and the nasutes.

The cycle in *Gnathamitermes* differs strikingly from that of *Tenuirostritermes* in several features. In addition to the workers, soldiers, and brachypterous nymphs, there were present in colonies of *Gnathamitermes* many apterous individuals like the workers but slightly smaller and with unpigmented heads. These proved to be the late nymphal instar of the sterile castes.

Beginning in early April some of these nymphs were found to be molting into the worker stage and from May 15 callow soldiers were found in some colonies. Therefore, the older apterous nymphs found in *Gnathamitermes* colonies may be of two types, one destined to become workers, the other to become soldier nymphs; or they may be indifferent, capable of giving rise either to workers or to soldiers.

Eggs were first found in *Tenuirostritermes* colonies on April 3. On April 24 eggs were first recorded in *Gnathamitermes* and probably first appeared there a week or two earlier. Eggs were abundant thereafter in the colonies of both species until our departure in late August, and presumably for some time after that.

The existence of the restricted period of reproduction in our species of Termitidae makes it possible to determine with certainty the lines leading to the several castes, since their appearance from the first eggs may be followed chronologically.

Thus, the junior author was able to trace, in some detail, the lines of development of the different castes of *Tenuirostritermes*. Conclusions made from field observations were checked by segregating the different stages and observing in the laboratory the stage derived from each by molting. The outstanding feature of her findings was that the three major lines leading, respectively, to the nasute, the worker, and the alate types are differentiated very early in development and can be distinguished readily from a very early molt—certainly the first molt for the nasutes and probably also for the other two castes. It seems safe to say that the nasute line is determined sometime during the first stadium. Both Emerson (*3*) and Bathellier (*1*) show the nasute-like "nasute nymph" molting from a pigmented, worker-like stage, whereas we found that the nasute of *Tenuirostritermes* molts from an entirely unpigmented nymph and confirmed this origin in the incipient colony. The reduction by one in antennal segments recorded by Emerson and Bathellier was found to occur also in *Tenuirostritermes*.

Nymphs initiating the worker line arise from large-bodied nymphs probably of the first instar. These do not molt until several days after the appearance of the nymphs of the nasute line.

The time required for the development of each of the various stages of the sterile castes in the primary colonies of *Tenuirostritermes* in the laboratory agreed closely with that in the first brood of the year in older colonies in the field.

The young of the alate line, made obvious by the possession of wing buds, arise from large-bodied young nymphs indistinguishable from those which give rise to the worker line. The first wing-budded nymphs were observed in August, after the alates had flown, whereas the nasute and worker lines were being renewed from the time of the first appearance of young, about May 1.

More than 400 pairs of dealated reproductives of each species were set up and allowed to develop as primary incipient colonies. Many of these seemingly developed normally. The incipient colonies of the two species were found to differ in the development of castes in the same ways as did the older colonies in the field. Flourishing incipient primary colonies of *Tenuirostritermes* consisted of from 15 to 20 nasutes and 45 to 55 workers. In *Gnathamitermes* colonies, the numbers were smaller (20–30), and no soldiers or workers appeared, all developing to the last apterous nymphal stage and remaining in that stage for months beyond the time when all members of *Tenuirostritermes* primary incipient colonies had become either workers or nasutes.

The conditions reported here make it obvious that primary colonies of *Gnathamitermes* are not favorable subjects for experiments on determination of castes, since the nymphs do not complete their development until the following year. The same is true for *Amitermes wheeleri*, whose reproductive cycle parallels that of *G. perplexus*.

The primary colony of *Tenuirostritermes* offers certain important advantages for experimental studies. The primary pair contain all the food necessary to allow the large primary group to develop to the definitive caste, worker or nasute. This development takes place rapidly, the first worker appearing about 60 days after setting up the dealated pair and the first nasute about 3 days later. It should be possible, therefore, to test the inhibiting effect of the presence of introduced workers or nasutes upon the caste development within such primary colonies.

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Lethal Effect of X-Rays on Marine Microplankton Organisms[1]

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Published literature concerning the effect of X-rays upon free-living microorganisms has dealt chiefly with fresh-water life. Ralston (*1*), however, found dosages of about 18,000 r lethal to *Dunaliella salina*. The present experiments deal with four genera of Protista obtained through the courtesy of Vance Tartar, of the State of Washington Department of Fisheries. These may be designated as (1) *Chlorella* sp. (Loosanoff's culture), a 2-μ, spherical green alga; (2) *Nitzschia closterium* (Loosanoff's culture), a diatom; (3) an unidentified green carteriid mastigophoran 14 μ long with four flagella, from Burley Lagoon, near Gig Harbor, Washington; and (4) an unidentified brown mastigophoran 8–10 μ long with two long flagella, from Rosedale, Washington.

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[1] This paper is based on work performed under contract No. W-28-094-eng-33 with the Manhattan District-Atomic Energy Commission.

On February 28, 1946, seven 5-cc. samples, taken in a random manner from each of the cultures, were removed to 1-dram shell vials for experimentation. The cultures filled the vials to a depth of about 38 mm. Two of each series, the first and the last removed, were used as controls. The other 5 vials were subjected at the rate of 132 r/minute to doses in roentgens of 1,000, 10,000, 25,000, 50,000, and 100,000. X-rays were produced at 200 kv. and 20 Ma. with filters of 1 mm. of aluminum and 0.5 mm. of copper. The target distance was 13 inches as measured to the middle of the depth of the culture in the vials. The vials were arranged in a cluster of 4-inch maximum diameter. On March 1 a second series of cultures was also exposed to the same amount of radiation, but in order to shorten the time of exposure the rate was increased to 530 r/minute by halving the target distance to 6.5 inches.

The number of swimming brown flagellates was determined by the use of blood-counting chambers immediately after the removal of the last vial from the X-ray machine. The dose that was immobilizing to 50 per cent of these organisms within 24 hours appeared to be about 50,000 r, while 100,000 r was almost 100 per cent effective. Viability was not readily ascertained in the other species. After irradiation the cultures were transferred to larger vials of 6-dram capacity, and 12 days later were subdivided, about two-thirds of each being removed to an 8-ounce jar. Several days later, when the culture had evaporated to about half of its original volume, the loss was compensated by adding sea water containing 0.1 per cent of milk. Population densities in the cultures were determined at irregular intervals by counting the number of organisms per unit volume of culture, using ruled blood-counting chambers.

TABLE 1

Summary of First Month's Counts Expressed as Percentage of Highest Count

Dose in r	*Chlorella*	*Nitzschia closterium*	Carteriid	Brown mastigophoran
0	100	100	80	29
0	83	72	100	100
1,000	94	67	67	66
10,000	75	34	61	37
25,000	58	20	46	0
50,000	43	12	14	0
100,000	23	8	81	0

The results shown are based on counts made only during the first month of the experiment. For the first 45 days there was general agreement in the effect upon all four organisms. Later tendencies of the counts extending to 5 months were erratic or obscure, possibly because of contamination of cultures. The concentrations of each organism at the various dosage levels are compared in Table 1. To arrive at these figures for a species, the counts in each irradiation group were averaged and then expressed as percentage of the highest average count for that species. The carteriid counts at the 100,000-r level were high and suggest faulty technique, but other counts were in general inversely related to amount of exposure above 1,000 r. The counts of cultures exposed to 50,000 r and 100,000 r were low.

Counts of cultures exposed to 1,000 r were not unlike the controls in that in 9 cases these were greater than, and in 10 cases less than, the controls. On this same basis of 19 counts for each culture the times that the 10,000 r treatment exceeded the control were twice; for 25,000-r, once; for 50,000 r, none; and for 100,000 r, once.

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The Contagious Nature of a Lymphoid Tumor in Chickens

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Nearly all treatises on tumors stress the point that little foundation exists in the theory that a tumor, or any agent responsible for a tumor, is communicable in nature. Arrayed against this theory of noninfection is the ever-increasing amount of data suggesting a virus etiology for certain tumors. The specificity of certain of the viruses and the indisputable evidence of infection, direct or indirect, that is associated with virus diseases, lead one to continue the search for a virus or virus-like agent which causes tumors and which is transmissible by contact with infected animals. Again, the knowledge which has been gained in an overall study of other diseases leads one to believe that, in the genesis of specific types of tumors, some orderly pathogenic stimulus is necessary to incite, directly or indirectly, neoplastic growth. Likewise, the myriad of seemingly spontaneous tumors occurring in the animal kingdom exists because certain necessary requirements of host-pathogen-environment relationship have been fulfilled.

In strains of mice susceptible to pulmonary tumors, it is not unusual to find that approximately 90 per cent of the animals at 18 months of age show "spontaneous" tumors (*3*). A description of these indicates such a similar host reaction that it is difficult to believe they were not activated by a common agent and that this agent, through some as yet unexplained manner, can find a portal of entry from one animal to another. Bittner (*2*), Andervont (*1*), and others have shown that mammary adenocarcinomas in mice were due primarily to the relationship between the genetic influence, the hormonal influence, and the milk influence in certain individuals. Discovery of an agent responsible for mammary tumors in mice was the result of carefully designed objective experimentation which included the development of host animals of similar genetic potentialities.

Among the important factors working against any experiment attempting to prove the communicable nature of agents responsible for tumors are the following: (1) If a tumor agent were transmitted by contact from one animal to another, the length of time which elapses before a tumor is grossly visible is generally too great to ascertain that such contact had any relationship to the tumor eventually formed. (2) It is almost impossible to be sure that the experimental animals are actually free of any tumor agent prior to the time of exposure. (3) There are not available enough experimental inbred animals which are uniformly free of, but susceptible to, the tumor agent studied. Until these and many other variables are controlled, the chances of proving contact transmission are slight indeed.

Research at the U. S. Regional Poultry Research Laboratory, carried on in active collaboration with a number of experiment stations within the region, is involved in an attempt to control lymphomatosis in the domestic fowl. Lymphomatosis is a naturally-occurring malignant disease of chickens characterized by the formation of lymphoid tumors which may be found in nearly all tissues of the bird's body. A review of the literature indicates that the lymphoid tumors associated with this disease are generally considered to be neoplastic entities.

Initial studies at this Laboratory started in 1939, at which time only hatching eggs were introduced onto the premises. Chickens obtained from these eggs were housed in completely new buildings. Exacting quarantine and sanitary measures provided for in all experimental work have been successful over a period of 8 years in preventing all common infectious diseases except lymphomatosis and all parasites of chickens except coccidiosis.

The first naturally occurring case of lymphomatosis at the Laboratory was observed about 40 days after the first chickens were hatched. During the first 600 days of life about 22 per cent of the chickens in this first population developed gross lymphoid lesions typical of the disease. For the past 7 years 20–40 per cent of the birds in each population have shown gross evidence of naturally occurring lymphomatosis. The presence of lymphomatosis in the first population, and the more or less complete absence of all other infectious diseases and parasites, provided very strong evidence of egg transmission, but it was not positive enough to remove all doubt. Accordingly, experiments were designed to provide more proof of such transmission.

The procedures followed consisted in selecting the eggs from certain hens and incubating, hatching, and rearing the resultant chickens by groups of families (a family consists of progeny of one sire and dam) in complete confinement and under extremely rigid quarantine (*8*). Altogether, 22 families of chickens were tested, and at the end of a 300-day period 9 of these (64 birds) had one or more individuals (a total of 16 per cent) showing gross lymphoid tumors, while 13 families (92 birds) showed no evidence of tumors. Sib controls of each of these 22 families were incubated, hatched, and reared with the main population of 1,074 chickens, of which approximately 34 per cent developed gross lymphoid tumors at 600 days of age. The 47 exposed sib controls of the 9 families showed 32 per cent with tumors; the 83 exposed sib controls of the 13 families, 21 per cent.

A second test consisted in selecting 4 females and 1 male, all sibs, from 1 of the 22 families showing no tumors. A mating (maintained in strict pen isolation) of these sibs produced 4 families consisting of 91 progeny which were incubated, hatched, and reared by families each in individual pen isolation. Control sibs and half sibs (121 in all) of these 4 families were incubated and reared with the mixed infected population consisting of 1,059 chickens. At the end of 300 days none of the isolated chickens in the 4 families showed gross lymphoid tumors, and 1 family of 17 chickens is still alive at 1,800 days of age. In contrast, 32 per cent of the exposed sibs and 20 per cent of the main population developed gross lymphoid tumors.

In a third test 4 female sibs were selected from among the progeny of the second-test chickens. Similar to the second test, these 4 females were mated to a brother, the resultant progeny again being incubated and reared by families, each in complete pen isolation. In this test at about 200 days of age, certain birds from 1 of the 4 families were diagnosed, upon gross necropsy, as showing questionable lymphomatosis, and the entire family was summarily destroyed. Of the remaining 3 families, consisting of 72 chickens, all were alive and apparently free of tumors at 350 days, at which time 23 birds were killed and no tumors found. The 49 remaining in this sample were killed at about 500 days of age, and only 1 bird showed gross lesions which could have been typical of lymphomatosis. About 44 per cent of the control sibs (165 birds) of these third-test families had gross lymphoid tumors at 500 days of age when exposed to a mixed infected population (1,014 birds), 35 per cent of which had developed gross tumors during the same period.

From these experiments several important conclusions relative to the communicability of this disease are justified: (1) Certain families of chickens highly susceptible to lymphomatosis can be reared either completely or relatively free of lymphoid tumors as well as all other recognized diseases and parasites (*8*); (2) the families of chickens showing no tumors were highly susceptible to lymphomatosis (*5*); (3) lymphomatosis is apparently a communicable disease, and the agent presumably responsible for it can be transmitted readily from bird to bird (*6, 8*); and (4) the egg is incriminated as a carrier of the agent responsible for the disease (*6, 8*).

The suggestion that a chicken tumor having the properties commonly associated with neoplasia is caused by an agent which is contagious is unique in the history of neoplasia as found in other animals. This raises the question as to whether the lymphoid tumors which characterize lymphomatosis in chickens do represent malignant neoplastic growth as described in other animals. Shimkin (*4*) cautions: "Agreement that the condition represents a malignant neoplasm is desirable, although it is realized that the criteria for malignancy are far from satisfactory and far from being sharply defined."

The experimental techniques used at this Laboratory to obtain inbred chickens relatively free of lymphoid tumors provide thought-provoking information on natural transmission, both by way of the egg and by bird-to-bird contact, and also information on the genetic resistance of the host (*5, 7*). How valuable free, susceptible chickens could be to oncological studies in the fowl is self-evident. If inbred chickens highly susceptible to specific lymphoid tumors, when reared by families in strict pen isolation, develop relatively few or no tumors, it can only be assumed that the actuating causes which promote tumor growth were not prevalent either in the chickens or in the environment surrounding them.

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IN THE LABORATORY

Radioactive Testosterone[1]

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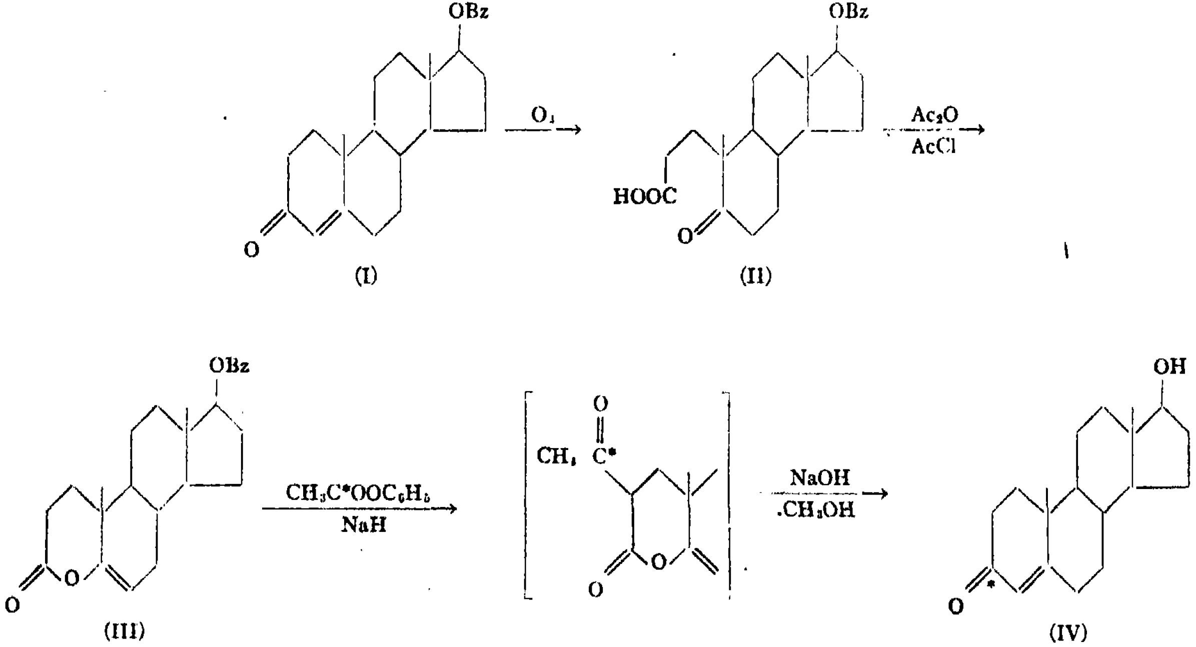
A method for the preparation of steroids labeled with isotopic carbon in ring A has recently been reported from this laboratory (*3*). This work has now been extended to the preparation of 3-radiotestosterone (IV), which is the first example of a synthetic radioactive sex hormone.



The procedure employed, outlined in the accompanying diagram, was essentially that reported previously for cholestenone (*3*). Ozonization (cf. *1*) of testosterone benzoate (I) afforded the keto acid II (m.p., 147–148°; $[\alpha]_D = +79°$) in a yield of about 65 per cent. *Anal.* Calc'd for $C_{25}H_{32}O_5$: C, 72.79; H, 7.82. Found: C, 72.83; H, 7.84. This substance was treated with acetic anhydride and acetyl chloride, and an enol-lactone (III) was obtained (80 per cent yield) which melted at 202–202.5°; $[\alpha]_D = -19°$. *Anal.* Calc'd for $C_{25}H_{30}O_4$: C, 76.11; H, 7.66. Found: C, 75.98; H, 7.74.

Condensation of III with phenyl acetate containing C^{14} in the carboxyl group proceeded smoothly in the presence of sodium hydride, yielding an oil which was treated directly with a methanolic solution of sodium hydroxide. The product, isolated by chromatographic separation on alumina, melted at 153–154° and did not depress the melting point of an authentic sample of testosterone. The identity of the substance was further established by measurements of specific rotation (+110°) and ultraviolet absorption ($\lambda_{max.} = 241$ mμ, $\log_{10} \epsilon = 4.21$). Testosterone acetate (m.p., 139–140°) was prepared as a derivative.

The above condensation reaction gave testosterone with an activity of 1.45×10^4 counts/min./mmole[2] in a yield of 48 per cent based on the enol-lactone (III). This substance and compounds of a similar nature may be expected to be of importance in connection with investigations of the intermediary metabolism of the steroid hormones and the relation of these hormones to cancer.

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[1] This work was supported by funds provided by the American Cancer Society on the recommendation of the Committee on Growth, National Research Council. The testosterone used in the investigation was made available through the generosity of Erwin Schwenk, Schering Corporation, and C. R. Scholz, Ciba Pharmaceutical Products, Inc.

[2] The author is indebted to Warren W. Miller, Radioactivity Center, Massachusetts Institute of Technology, for activity measurements. For a description of the counting method see reference *2*.

Inhalation of Penicillin Dust

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In view of the favorable reports in recent literature on the inhalation of therapeutic agents, especially penicillin, and because of the many possibilities of the method, we have attempted to produce even greater and more protracted topical effectiveness by a method which involves the inhalation of the fine dust aerosol particles. This method has simplified the mechanics of aerosol therapy, thus expanding its scope more readily for office and home treatment.

Apparatus used for inhalation therapy in the past has been based on the delivery of the aerosol vapor under positive pressure of oxygen or air by means of a hand bulb or oxygen tank and gauge. The principle utilized in the new method is based on the negative pressure created by normal breathing during the inspiratory phase. Inhaling penicillin dust in this manner is more physiological and permits a more even and perhaps a wider distribution of medicament throughout the respiratory tract. The patient is not required to manipulate an exhaling valve during the expiration phase, and the cumbersome equipment of oxygen tank and gauge is unnecessary. The inhalation of the dust particles yields a greater effect than the vapor, because there is greater concentration of penicillin per unit area and because the penicillin must go into solution while in contact with mucous membrane before it can be absorbed.

The penicillin dust used in this study was crystalline sodium penicillin[1] processed to #50–100-mesh particles. This was found to be less hydroscopic than the sodium penicillin salt and could be stored at room temperature, without losing its potency, more readily than the penicillin liquid which was used as the nebulin for the vapor method.

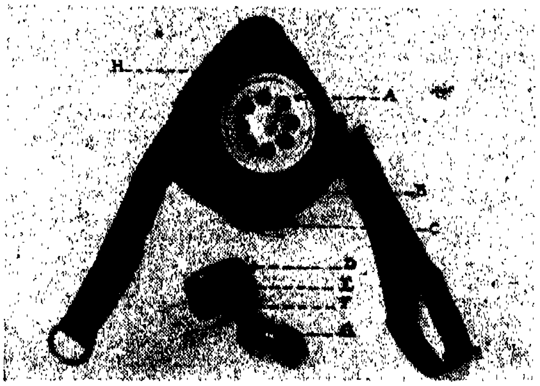

FIG. 1

The apparatus[2] represents numerous modifications of the original device, since penicillin dust possesses certain qualities which do not lend themselves to ordinary techniques. Penicillin is highly electrostatic, easily adhering to surface areas. In addition, it is hydroscopic and goes into solution readily. The technique finally developed allows the penicillin to be easily released as a dust and at the same time precludes the moisture of exhalation from dissolving the dust.

The device (Fig. 1) consists of an oronasal facepiece which is held on by an elastic headband. The front of the mask contains a large exhalation valve (A) in direct line with the stream of exhaled air. The portion of the mask about the chin contains a rubber sleeve (C) fitted with an inhalation valve (B), which directs the inhaled air in a plane at right angles to the stream of exhaled air. This valve contains a special detachable metal chamber (D) containing the penicillin dust. The penicillin chamber is fixed with a fine wire-mesh platform (E), which is covered with a finely perforated cellophane paper (F). It has been found that penicillin dust is essentially nonadherent to cellophane. The dust is placed on top of this platform. During the inhalation, air drawn through the perforations of the penicillin chamber releases the dust, which passes through the inhalation valve and into the respiratory passages. The dust is protected from the moisture of exhalation by the one-way inhalation valve and by the fact that the exhaled air is conducted through a plane at right angles to the inhaled air. A small hole (H) about 6 mm. in diameter, on top of the mask just above the end of the nose, allows a substantial amount of air to be drawn in easily and avoids any feeling of "resistance" on inspiration. This supplementary inlet for air is also necessary to keep the amount of penicillin dust inhaled in optimum quantities.

This preliminary work, begun in October 1946 and extended through February 1947, comprises studies of 68 subjects (38 males and 30 females). Four experimental subjects (including the authors) inhaled the penicillin dust in varying proportions in order to detect any untoward effects or irritating properties. Fifty-five patients had upper respiratory infections: 46, symptoms of the "common cold"; 4, chronic nasopharyngitis; 3, chronic sinusitis; and 2, laryngotracheal bronchitis. Nine patients had lower respiratory tract infections: 6, bronchiectasia; 2, chronic bronchitis; and 1, bronchial asthma.

All patients received 100,000 units of penicillin dust by inhalation for 20 minutes three times a day. Throat and nose cultures prior to first treatment and daily cultures thereafter were taken on all hospitalized patients. Sputum cultures were taken in cases of bronchiectasia. Single blood-level determinations were made on various patients in this group. The duration of therapy was determined clinically and bacteriologically for each case.

The inhalation of dry penicillin quickly causes the reduction or disappearance of gram-positive bacteria and, in the massive doses used, seems to effect some of the gram-negative bacteria. This is accomplished readily, often in one treatment. Penicillinase has been added to the laboratory specimens without changing the bacteriologic results.

The clinical results were based on the patient's subjective improvement, the opinion of attending doctor, and the impressions of the authors. A study of the data of the 6 bronchiectatic patients revealed less cough and secretion on dismissal. The patient with bronchial asthma showed marked improvement, the infectious condition almost completely disappearing, although the allergy persisted to a decreased degree. The 2 patients with chronic bronchitis showed a moderate improvement. The symptoms of over 70 per cent of those patients with acute conditions of the upper respiratory tract cleared up markedly, in many instances after only one or two treatments. Seventy-five per cent of the patients with upper respiratory tract infections had only one treatment. Six had two inhalations, and three had four treatments. The remainder had 4–18 inhalations, the highest number being reserved for the chronic bronchitis and chronic sinusitis. The range of duration of treatments for the patients with diseases of the lower respiratory tract was 10–18 treatments, administered in from 4 to 6 days.

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[1] The penicillin for this study was processed by, and furnished through the courtesy of, the Abbott Laboratories, North Chicago, Illinois.

[2] The present mask was kindly fabricated by the Chicago Eye Shield Company, according to specifications of one of the authors (Krasno).

It is singular that up to the present time no sensitivity reaction to the penicillin has been noted. With the vapor aerosol method, transient fever, dyspnea, or dermatitis has occurred in 4–20 per cent of the cases, depending upon the concentration of the drug used.

Penicillin assays of urine and blood were determined by the Flemming modification of the Wright slide cell technique. Values ranged from .03 to 1.92 units/cc. Blood-level curves would indicate a slow absorption, the maximum level being obtained 3-3½ hours after the inhalation.

This new method of administering penicillin appears to offer more effectiveness than other aerosol methods in ridding the upper respiratory tract of gram-positive bacteria. Appreciable blood levels would indicate the protracted effective absorption offered by this method, and the possible use of inhalation treatment for systemic conditions other than those of the respiratory tract. Although the method would appear to have a definite value in initiating the process of ridding the respiratory tract of pathogens, it may be necessary to supplement the process with other medicaments. In other instances its value may be adjunctive rather than primary.

Formaldehyde in Plant Collecting

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Recently Schultes has published an intelligent and much-needed discussion of the use of formaldehyde in the preparation of herbarium specimens, recommending its use to prevent disarticulation, molding, and decay when immediate drying is impractical (*Rev. Fac. Agron.* (Medellín, Colombia), 1946, 6, 46-52; *Rhodora*, 1947, 49, 54-60). His development of this method resulted from a conversation with Paul H. Allen, who has for some years employed alcohol and formaldehyde in the preparation of his excellent specimens of Panamanian plants.

Since I was present at the conversation referred to and have independently developed a somewhat different formaldehyde technique, it seems worth while to supplement Schultes' papers with an account of some of the possible variations and certain minor drawbacks, as well as to publish the method where it will reach a wider audience.

Allen's original method was to spray the freshly pressed specimens, using a common Flit gun, with a mixture of 70 per cent alcohol and enough formaldehyde to give it a strong odor. I tried this, but found that the specimens still molded and deteriorated to a certain extent, especially when final drying was delayed for a considerable time. Spraying with a Flit gun had the additional disadvantage of practically pickling the collector as well as his plants.

Much experimenting finally resulted in a mixture that seems to work under most conditions and has one big advantage over the straight formaldehyde-water solution advocated by Schultes. This mixture consists of approximately 1 part each of concentrated (40 per cent) formaldehyde, 95 per cent alcohol and water. If 70 per cent alcohol only is available, as in many small towns, I commonly use 1 part formaldehyde and 2 parts alcohol. The alcohol gives the mixture much better wetting properties than those of a straight water solution. Not only does it readily wet even waxy leaves and those with a prominent coating of hair or scales, but it also penetrates much more quickly and thoroughly.

After I had suffered an atmosphere of formaldehyde spray from a Flit gun for several trips, Norman C. Fassett suggested applying it with a small paint brush. This method was much more effective and lacked the unpleasant features. I had already discarded the dipping method as rather ineffective and clumsy at best, and completely unsuited to plants that tended to be limp. Of the three methods, use of a soft, 2-inch paint brush is by far the most satisfactory. H. H. Bartlett (in a letter) has suggested a rather different method which consists essentially of tying a fair-sized bundle of specimens together in folded newspapers, standing them on end, and pouring a sufficient amount of the solution described above into the bundle to wet it.

It is usually suggested that after the application of formaldehyde the bundles of specimens be wrapped in oilcloth, waxed paper, pliofilm, double canvas, or other material to retard evaporation. If specimens are to be mailed, this is doubtless necessary, since otherwise they would probably not be accepted by postal authorities. However, I have found that there are no evident bad effects if they are left simply wrapped in either wrapping paper or several thicknesses of newsprint. The solution largely evaporates off after killing the tissues of the plants as well as the spores of such fungi as are likely to cause trouble. The dead tissues lose their water much more readily than do living ones, and drying goes on to a certain extent even in the bundles. Subsequent drying over heat also takes place much more rapidly for this same reason.

Those to whom the color of the finished specimens is of importance will not find any of the methods employing either formaldehyde or alcohol very satisfactory, since the specimens are practically always either discolored or bleached. However, few collections from wet tropical regions, prepared by any method, have been preserved in anything like their original colors; furthermore, a few years in the atmosphere of the large cities in which our herbaria are unfortunately located soon makes the original color unimportant. Colors, if of any importance, should always be recorded on the labels.

I regard the formaldehyde method, not as something that should supersede the ordinary method of drying the plants over heat after a few hours in a tight press, but as a supplementary method for use in places where ordinary drying is difficult and with material that is not satisfactorily prepared by the ordinary methods. Leaving the material in a wet condition for any considerable length of time cannot have a good effect and probably results in a certain amount of brittleness. However as Schultes very effectively points out, many groups of plants that make traditionally bad specimens give very gratifying results with this technique. One has only to look into the covers of almost any genus of tropical mimosoid legumes to be convinced that improved methods are in order. Certain of these which were not dried for three weeks after gathering show no tendency whatever to lose their leaves. The formaldehyde apparently completely and instantaneously stops the formation of abscission layers. It might be well to try this technique on such conifers as *Tsuga* and *Picea* and on the almost mature cones of

Abies, of which I have seen few satisfactory specimens because of the dropping of leaves and cone scales on drying.

The tissue-killing effect of this solution also lightens immeasurably the burden of preparing material of such difficult plants as Crassulaceae, Portulacaceae, Aizoaceae, and other fleshy groups, even in a dry climate.

Direct Introduction of Chemical Substances Into Herbaceous Plants[1]

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During studies concerned with the effect of 2,4-D upon plants the need for a means of introducing chemicals into any desired part of herbaceous plants, without either injuring the plant itself or taking up too much of the experimenter's time, became obvious. The principal methods of treatment hitherto used have major drawbacks.

The solution to be tested is placed upon the upper surface of a leaf blade either in the form of a drop or in a small disk of filter paper (*2, 3*). Also, pellets containing mixtures of a paste-like carrier and growth regulators have been used (*1*). Necessarily, these treatments are limited to those organs of the plant which, by virtue of their shape, support a drop of liquid or a disk of moist filter paper. They are not feasible for application to erect or inclined parts or to surfaces of a repellent or impermeable nature. The injection method (*4*) is not practicable with herbaceous plants in large-scale experiments because it is too time consuming; also, the inner turgor of the tissues usually prevents penetration of additional fluids from outside, and the cells are readily injured or ruptured when even a minimum of liquid is forced into them.

A good deal of knowledge is still lacking with regard to the fundamental facts about the mechanism of growth, metabolic systems, and correlations between physiological and morphological developments in plants. This ignorance may be due to inadequate means employed in tracing and analyzing various phases of reactions which take place in the intact growing plant.

Attention is called here to a technical device used by Winifred O. Roberts (*5*) in diagnosing mineral deficiencies in leaves, and also developed independently by the author for experiments with plant growth regulators. The fact that essentially the same method was conceived by researchers of different countries seems to confirm the need for, and the versatility of, the technique.

Needles formed from florist steel wire No. 30 are threaded with 2–3 inches of white mending cotton. The thread is soaked to saturation in the solution to be tested and drawn through the desired part of the plant. The needle is then severed from the thread, the latter being left inside the tissue (Fig. 1). If a continuous supply of a substance is desired, the end of a longer thread may be left immersed in the solution, thus serving as a wick. Powdered substances may be introduced similarly by making them adherent to a slightly moistened thread. If the exact amount of introduced substance is to be determined, the thread may be dried after soaking and the differences in weight of the treated and untreated threads calculated for any given length. It has been observed that a thread impregnated with a solution of 2,4-D, dried, and then introduced is equally effective.

There was no instance of a detectable effect from puncturing the tissues with the needle or introducing a thread soaked in distilled water. In order to avoid contact of the plant sap with metal, the wire may be replaced by a plastic or glass-fiber material. The time factor involved in using this method for experimental purposes is negligible. An unskilled worker can prepare 60–80 needles per hour, and the treatment of 150 plants requires about one hour.

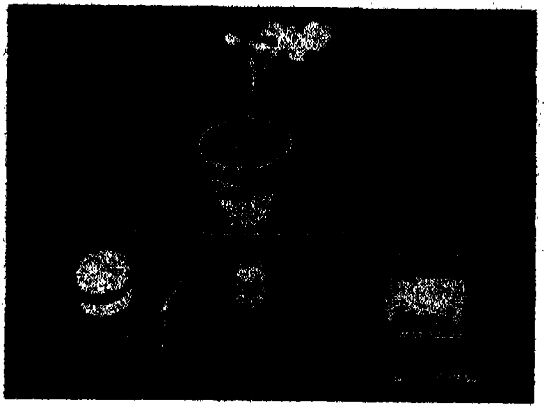

FIG. 1. Thread introduced in the first node of a bean seedling (above), and tools used in preparing threaded needles (below): wire, mending cotton, scissors, flat forceps, and glass bottle for soaking threads. Square glass jar (right) is used for storage of threaded needles.

The "thread method" already has been used successfully in experiments conducted to test (1) the responsiveness of specific morphological parts of bean plants to 2,4-D, (2) the transport of 2,4-D within the plant, (3) the effect of 2,4-D in relation to acid and alkaline systems of plants, and (4) the pH in the growing plant, by using threads impregnated with indicator solutions. In some of the experiments several thread tests involving various time intervals between the single treatments, have been used on the same plant. A detailed report of these studies will be published elsewhere.

This method seems to be useful in cases where (1) specific areas of a plant cannot be reached by applying a drop, (2) minimum amounts of a substance are to be introduced, and (3) the capacity of specific tissues is to be tested relative to absorption, accumulation, or transport of metabolic or artificially introduced substances. The method offers innumerable possibilities of experimental tests with normal and diseased plants and may facilitate new discoveries of both morphological and physiological correlations and the fundamental mechanism of growth.

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[1] Authorized for publication as Journal Article No. 881 (n.s.) by the director, Michigan Agricultural Experiment Station.

Book Reviews

Handbuch der Katalyse. Vol. 3: ***Biokatalyse.*** G. M. Schwab. (Ed.) Vienna: Springer, 1941; Ann Arbor, Mich.: J. W. Edwards, 1945. Pp. 622. $19.00.

This extremely valuable volume contains five parts, all of which are of considerable interest to the enzymologist. The opening section (46 pp.), by A. Schäffner, is concerned with the general properties of enzymes, their preparation, and the nature of enzyme action. The second and longest section (245 pp.), prepared by H. Kraut, M. Rohdewald, A. Weischer, and E. Kofranyi, deals with the hydrolysing enzymes, which are classified and are individually considered in terms of their occurrence, estimation, preparation, and properties.

The third section, which is the only one printed in English, is a complete (214 pp.) and well-documented treatise on biological oxidation-reduction catalysts by K. A. C. Elliott. Although the book is now several years old, this section is an invaluable aid to the investigator who wishes to obtain a detailed account of the oxidative enzymes as a basis for the study of current reports. Students and teachers will find a wealth of material that is not available in any other more recent source. The section includes 8 chapters, one of which is an excellent chapter on "Carriers."

The fourth section, by A. Schäffner and H. J. Jakowatz, is entitled "Viruses From the Standpoint of Catalysis and Autocatalysis" (39 pp.). It is concerned mainly with the mechanism by which the normal cell proteins are rebuilt into virus protein.

The fifth section, by G. M. Schwab and F. Rost, is concerned with enzyme models (37 pp.) and provides a summary of many catalyses which simulate enzymatic catalysis.

The volume includes an extensive author and subject index.

VAN R. POTTER

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Inorganic syntheses. (Vol. II.) W. Conard Fernelius. (Ed.-in-Chief.) New York-London: McGraw-Hill, 1946. Pp. xii+293. (Illustrated.) $4.00.

This second volume of a series giving tested procedures for the preparation of inorganic substances is characterized by the same high standards as the well known Volume I, and it should be on the bookshelf of anyone who has occasion to prepare or purify inorganic substances. The great virtue of the book, like its predecessor, is that every procedure has been critically evaluated and tested independently in a laboratory other than that in which it originated. The names of the original authors as well as those who checked the method are given under each procedure. In this connection the following quotation from the Preface is pertinent: "Inasmuch as the syntheses in Inorganic Syntheses originate from individual contributors, the editors have been perturbed to find specific references to Volume I that do not mention the individual contributor. The editors prefer that Inorganic Syntheses be considered as a periodical when references are given and that credit be given to the contributor."

The syntheses are arranged in 8 chapters, numbered according to the groups in the Mendeleev periodic table. Each of the 81 methods given starts with a brief introduction, which is followed by a detailed procedure and finally by a short discussion of the properties of the substance concerned. Each synthesis concludes with key references to the original literature. In many instances two or more alternate procedures are supplied. Very well-executed drawings of special apparatus accompany many of the procedures.

Since the inclusion of any synthesis in a given chapter on the basis of the periodic table is somewhat arbitrary, a list of syntheses which are presented in other chapters but which might have been included in the chapter in question are given at the beginning of each chapter. Cumulative subject and formula indexes to both volumes render easy the location of any particular syntheses.

The nomenclature adopted in this volume conforms, in general, with the rules recommended in 1940 by the Committee for the Reform of Inorganic Chemical Nomenclature of the International Union of Chemistry, and with *Chemical Abstracts* usage. These rules are explained by Janet D. Scott in a 10-page appendix.

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General biology. (2nd ed.) Perry D. Strausbaugh and Bernal R. Weimer. New York: John Wiley; London: Chapman & Hall, 1947. Pp. viii + 718. (Illustrated.) $4.75.

After a concise treatment of protoplasm and the cell, the second edition of Strausbaugh and Weimer's *General biology* proceeds rapidly to a consideration of carbohydrate synthesis in plants. The succeeding chapters deal in logical sequence with digestion and absorption, food transportation, respiration, and excretion in both plants and animals. In a text so complete and well illustrated as this, no objection should be offered to the parallel consideration of transpiration in plants and excretion in animals as long as adequate contrasts are drawn. The new chapter on hormones and auxins is thoroughly up to date. Growth and reproduction are considered in the same chapter, and meiosis is postponed wisely until the chapter on heredity.

The usual survey of the animal and plant kingdoms is well balanced within the confines of 200 pages. Ecology and evolution are given a broad presentation in the next two chapters.

The style of the book attains conciseness without the dull, laconic quality sometimes observed in texts covering so broad a field. Physiological concepts are stressed at a level that is neither superficial nor confusing in technicalities.

Index and glossary are combined, and bibliographies are eliminated except for occasional footnotes. Long book lists serve no practical purpose, since most instructors prefer to select their own supplementary readings.

The typography and well-labeled illustrations are excellent and, for a full-year course, the text is highly recommended.

GEORGE L. CHURCH

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The Role of Microorganisms in Acid Mine Drainage: *A Preliminary Report*

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SOME WATERS ISSUING FROM BITUMINOUS coal mines are near neutral or alkaline in reaction, and, as such, are not considered to be of great importance in the problem of stream pollution. This is not the case with acid mine waters. Waters of this class are objectionable, and their disposal has engaged the attention of the many agencies concerned with water conservation and with the abatement of stream pollution. Carpenter and Herndon (*1*) and Hodge (*2*) have reported analyses of this type of mine drainage. Analyses of these waters vary widely from mine to mine and from coal seam to coal seam. One sample of acid mine water had a pH of 2.9, and the total acidity, sulfates, and total iron were 1,375, 3,560, and 460 ppm, respectively. The comparable figures for another acid drainage were: pH 1.4; total acidity, 47,800 ppm; sulfates, 41,700 ppm; and total iron, 12,270 ppm. Hoffert (*3*) has reviewed recently the status of acid mine drainage as one of the important industrial wastes.

Attempts at solving the acid mine drainage problem. In the past, extensive programs for air sealing acid-producing abandoned coal mines have been undertaken with the purpose of reducing both the volume of the acid waters issuing from the mines and the amount of soluble acidic materials dissolved in them. It has been assumed that if the volume of surface waters gaining admission to such mines could be reduced, less of the objectionable acid drainage would be formed. It has also been assumed that if atmospheric oxygen could be cut off from the mine, or if the concentration of the oxygen present in the mine could be markedly reduced, less oxidation of the sulfur and sulfur-bearing compounds of the coal beds would result, and thus smaller amounts of acid compounds would be available for solution in the water. The following reaction indicates what is assumed to take place when the iron disulfides are oxidized:

$$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2FeSO_4 + 2H_2SO_4 \qquad (1)$$

In addition to attempts to limit the acid mine drainage at its source, work has been done on modifying the acid drainage issuing from bituminous coal mines. Chemical treatments have been studied to rid these waters of undesirable constituents or to modify their composition so that they would no longer be considered objectionable. However, because of the cost of such chemical treatments and the unsolved problem of disposing of the large quantity of sludge which would be produced, no feasible process has been devised.

Normal changes in acid mine drainage after its formation. It has been assumed generally that the change of clear acid mine water to the characteristic amber or rusty color, which the water soon acquires after exposure to the air and which aids in making this type of pollution so objectionable, is due to the atmospheric oxidation of ferrous to ferric sulfate. The subsequent hydrolysis of the latter compound yields ferric hydroxide. This compound and hydrated iron oxides cause the marked rusty-colored water and precipitates in the water courses. The formation of the ferric sulfate and its hydrolysis may be shown by the following equations:

$$4FeSO_4 + 2H_2SO_4 + O_2 \rightarrow 2Fe_2(SO_4)_3 + 2H_2O \qquad (2)$$

$$Fe_2(SO_4)_3 + 6H_2O \rightarrow 2Fe(OH)_3 + 3H_2SO_4 \qquad (3)$$

When bottles of clear acid water, taken from abandoned areas of bituminous coal mines (Pittsburgh seam) in Monongalia County, West Virginia, were stoppered so that no air space existed, the water remained clear even after weeks of storage. However, if a bottle was only half filled with water so that air was readily available, the amber color was formed within 24 to 48 hours, the deeper color being formed upon longer standing. Also, if clear acid mine water was placed in a container and carbon dioxide allowed to bubble through it, the amber color was not formed after a week; yet, if another container of the same water was exposed freely to the air, the color formation was rapid. If the passage of the carbon dioxide was stopped and that container then exposed to the air, the amber color developed in that water. In other words, air influences the characteristic change from the clear to the amber-colored water.

While it has been known that some members of the *Chlamydobacteriales* have an iron compound in their sheath after growing in iron-bearing water, the role that microorganisms might have in inducing changes in the iron compounds of acid mine drainage appears to have been overlooked. The purpose of this preliminary report is to show that microorganisms do have an active role in the above interrelationship and to propose that the formation of sulfuric acid within the mine may be due to microbial action.

This paper is published with the approval of the directors, Agricultural Experiment Station (Scientific Paper No. 373), and Engineering Experiment Station, West Virginia University.

The role of microorganisms in the oxidation of iron in acid mine drainage. That the presence of air is not the sole criterion of whether the water's ferrous sulfate will change to ferric sulfate will be seen from the following simple experiments. If mercuric chloride, phenol, or formaldehyde—known disinfectants—are added to clear acid mine water in concentrations varying from one part per thousand to one part per hundred billion, the amber color starts to form in the water containing the smallest concentration of the chemical and in the control. It has been noted that for any chemical the appearance of this color varied with the length of incubation. Some of the waters containing the smaller concentrations of the chemicals may be clear after a week, but upon continued incubation they become amber. However, it was found that a concentration of one part per million of mercuric chloride, one part per thousand of phenol, and one part per ten thousand of formaldehyde prevented any formation of the amber color, irrespective of the length of holding.

In another test toluene was added to a half-filled bottle of clear acid mine water and the container closed. There was no amber color formation. Again, if clear mine water is filtered through an "E.K." germicide pad of a Seitz filter and this sterile water, in sterile cotton-stoppered containers, is exposed to the air, no amber color is produced. Too, if a synthetic mine water, made from distilled water and the iron disulfide (pyrite and marcasite) contained in the "sulfur balls" from acid-producing bituminous coal mines, is treated similarly, no amber color is produced in it after weeks of air exposure.

Thus, since the addition of bactericides such as mercuric chloride, formaldehyde, and phenol and a bacteriostatic agent such as toluene prevents the change from clear water to the amber color of these air-exposed acid mine waters, and since a Seitz-filtered water, where particles of microscopic size are removed, behave similarly, there is strong evidence that atmospheric oxygen is not the only agent involved in the formation of the undesirable hydrated oxides of iron. That this view is valid may be demonstrated by inoculating a Seitz-filtered portion of acid mine water or a Seitz-filtered portion of synthetic mine water with raw, untreated acid mine water. The characteristic amber color is then produced in the inoculated water.

To determine the nature of the microorganism or microorganisms concerned, 1 ml. of the raw water which had just turned amber was inoculated into 10 ml. of clear acid water sterilized by Seitz filtration. When this became amber, it served as the inoculum for a second tube of this sterile water. After such serial transfers had served to enrich the agent or agents present in the colored water, a portion of the liquid from the last amber tube was streaked on the surface of a poured agar plate composed of equal volumes of sterile mine water and 3 per cent agar-agar. After 6–10 days of incubation at room temperature (22–28°C.), an amber color appeared in the agar, and very small colonies were apparent in and around the colored areas. Pure cultures of the bacteria were secured by repeated replating upon the acid-water agar. Microscopic examination of the organisms of the colonies proved the presence of gram-negative, nonsporeforming rods approximately 0.4 μ wide by 0.8–1.0 μ long. When either sterile, raw acid mine water or synthetic acid mine water was inoculated with this bacterium, the waters became amber and formed the typical rusty precipitate, whereas uninoculated sterile control tubes of the same waters remained clear. Thus, a bacterium has been isolated in pure culture which is capable of growing in acid mine water and in bringing about the oxidation shown in Equation 2. One of the acid waters commonly used as the substrate in the tests had a pH of 2.2 and a total acidity of 7,938 ppm as calculated from its titration with N/50 NaOH in hot solution to the phenolphthalein endpoint. Attempts to grow these iron-oxidizing bacteria in the synthetic sulfur medium of Waksman and Starkey (*12*) (which serves as an excellent substrate for *Thiobacillus thiooxidans*, a well-known sulfur oxidizer acting at low pH) have failed. Further morphological, cultural, and physiological studies are being made on the organism.

Besides the bacterium mentioned above, several fungi have been isolated from acid mine drainage. None of these seems to be an agent causing rapid oxidation of ferrous iron to ferric iron. One of the isolates has been tentatively placed in the genus *Spicaria*.[1] Microscopic examination of wet mounts of it growing in this water shows a compound of iron to be precipitated on the fungal spores and mycelium. On the solid substrate of this water the characteristic amber color is formed.

Are microorganisms involved in the formation of acid mine drainage? Equation 2 shows the change which takes place in the oxidation state of the iron of the acid mine water after this water has been produced. The finding that microbial activity is involved in this oxidation, and that atmospheric oxidation is not the sole factor, is an interesting one, yet in itself it is a decidedly minor part in the major problem concerned in this type of industrial waste.

The major problem deals with the actual production of acid water in the mine. Several questions now arise: Is Equation 1, the accepted reaction for the formation of the offensive materials of the acid drainage, solely an atmospheric oxidation phenomenon, or are microorganisms involved there also? Are the abandoned areas of the acid-producing bituminous coal mines capable of supporting microbial growth? Are there any microorganisms known which can use the substances present in these areas in their life activities and produce, as by-products, the offending materials found in acid mine drainage?

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[1] We are indebted to H. L. Barnett for aid in identifying this fungus.

Carpenter and Herndon (*1*), in studying the sterilizing effect of acid mine waters on domestic sewage, noted the growth of an organism on their plates of nutrient agar at or near a pH of 3.0 which they identified as "*Thiobacillus thiooxidans* or a very closely related species." None of the tests used by them to arrive at such a conclusion was given. Their attempts to find the organism responsible for the acidity of the acid mine water were unsuccessful. Various coals were examined by these workers for the possible role of microorganisms in the change of the sulfur content. By comparing sterilized with nonsterilized portions they concluded that at least part of the sulfate produced in acid mine water can be attributed to bacteriological action.

In our laboratory some exploratory tests made on acid drainage have given interesting results with regard to the possible significance of bacteria in the formation of the sulfuric acid in the mine. Although numerous water samples have been studied, the sources of four typical samples are given. In one instance the water sample was taken outside of the mine from the flume into which pumps had emptied the drainage taken from an abandoned area several hundred feet below the earth's surface. In another the water was taken inside the mine as it ran out of an abandoned area and flowed along the main haulage way. A third sample came directly from an abandoned area and was caught as it issued from a bore hole in the coal. A fourth was taken from a strip mine where the water was running out of a spoil bank.

All the waters were inoculated into the synthetic medium of Waksman and Starkey (*12*), used for the culturing of *Th. thiooxidans*.[2] Growth appeared in all the inoculated flasks within 7 to 10 days, and, at that time, subcultures were made into fresh media. Repeated transfers have always yielded an active culture. Material from the flasks was streaked on the surface of the solid sodium thiosulfate medium of Waksman (*11*), and minute straw-yellow to cream-colored colonies were produced. Thus, a second bacterium has been isolated from acid mine drainage. Whereas the first bacterium was instrumental in the change of ferrous to ferric iron, attempts to grow it in the sulfur medium have failed. The second, however, will rapidly oxidize sulfur to form sulfuric acid, but attempts to have it oxidize the ferrous iron of the acid water have failed.

Growth taken from the liquid or solid substrate was morphologically similar to the published descriptions of *Th. thiooxidans*. Physiologically, the organism fits the description of the known sulfur oxidizer. It can satisfy its carbon requirements from the carbon dioxide of the air; its nitrogen can come from ammonium sulfate; and its energy can be derived from the oxidation of elemental sulfur or thiosulfate. The pH of the liquid medium varies from 1.5 to 0.9 after one to two weeks of growth.

Consideration of environment where acid mine drainage is produced with reported activities of Th. thiooxidans. It is felt that since all of the typical acid mine waters sampled have yielded organisms which fit the description of *Th. thiooxidans*, it is worth while to consider the possibility of its acting as the agent in the formation of sulfuric acid in the abandoned areas of bituminous coal mines. If one considers the actual environmental conditions existing in such areas, the possibility of this organism functioning there is quite striking.

Two gas analyses, made on abandoned areas from which one of the samples of water was taken, showed the absence of carbon monoxide in both. The methane values were 12.4 and 18 per cent; the oxygen concentrations were 3.2 and 9.4 per cent; whereas the carbon dioxide values were 3.5 and 3.8 per cent. The work of Vogler and Umbreit (*10*) indicates that *Th. thiooxidans* would not find some of these gaseous components of this area prohibitive to its action. These workers ran experiments using pure cultures of *Th. thiooxidans* in which the gaseous environment varied from 10 to 30 per cent of oxygen and from 0.01 to 10 per cent of carbon dioxide. By using the sulfate sulfur, formed by the oxidation of elemental sulfur, as a measure of the activity of the organisms under the experimental conditions, they felt their data showed that "a small amount of variation is evident, but that variation bears no consistent relation to either oxygen or carbon dioxide pressures. Significantly, the oxygen can be decreased to half its value in air without detectable influence upon the rate of sulfate formation." A study of the work of Vogler (*8*) brings out the striking ability of this organism to modify its activities under the influence of carbon dioxide. Indeed, he postulates that the "carbon dioxide may act as an oxidizing agent for sulfur."

It is well known that the waters issuing from these abandoned areas of acid producing mines are quite acid and have a high sulfate content. Waksman and Starkey (*12*) long ago called attention to the unusual property possessed by *Th. thiooxidans* of being able to grow when the medium contained 0.5 M concentration of sulfuric acid, equivalent to nearly 5 per cent concentration of the acid. Starkey (*6*) found that oxidation proceeded most rapidly between pH 2.5 and 3.5, although oxidation of sulfur is very rapid over a very much wider range. Above 6.0 there is practically no oxidation of sulfur in the culture medium by *Th. thiooxidans*. Vogler, LePage, and Umbreit (*9*) reported that above a pH of 5.0 there is a marked inhibition of sulfur (and thiosulfate) oxidation, but there is little effect upon the endogenous respiration in the absence of sulfur. These workers felt that the organism is adapted to just that range of H-ion concentration in which free carbon dioxide is dissolved in the medium as a gas. Waksman and Starkey (*12*) and Starkey (*6*) have noted that *Th. thiooxidans* is quite tolerant to the sulfate ion. The latter states: "However, the end product of sulfur oxidation (sulfate) is tolerated by

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[2] A pure culture of *Th. thiooxidans* was obtained from R. L. Starkey, to whom we are indebted for this favor.

Thiobacillus thiooxidans in as high concentration as 20 per cent in the form of magnesium sulfate."

The temperature of the acid waters issuing from the abandoned areas tends to be below 20°C. Vogler, LePage, and Umbreit (*9*) found that sulfur oxidation proceeded over a temperature range of 7° to 45°C.

Thiessen (*7*) reported that sulfur in all coals is "present in amounts ranging from traces to as high as 10 or more percent, commercial coals of the Eastern United States contains from 0.5 to 1.5 percent of sulfur." Thiessen stated that sulfur does not occur as such in coal but is present in organic combination as part of the coal substance and in inorganic combination as pyrite or marcasite and, especially in weathered coals, as calcium sulfate. Mellor's (*5*) compilation is a rich source of information dealing with the iron disulfides, pyrite and marcasite. Two of the many items of interest concerning these inorganic combinations of iron and sulfur are the statements concerning the weathering or the ready breakdown of marcasite under the influence of moist conditions and the finding of free sulfur in the naturally-occurring iron disulfides.

Kirner (*4*) reports that bituminous coal has a nitrogen composition ranging from 0.6 to 2.8 per cent. The complete story of the forms in which this nitrogen may appear in the coals and, indeed, whether such compounds are available to microorganisms is not known. Starkey (*6*) found that with *Th. thiooxidans* there is some oxidation in media receiving no nitrogen other than that which may have been absorbed from the air or introduced as impurity in the non-nitrogenous compounds incorporated in the medium. Of the nitrogen sources investigated, ammonium nitrogen is the only one that has been found to be available to the organism.

In this work, a bacterium, unidentified as yet, has been found in acid mine drainage which is involved in the oxidation of ferrous to ferric sulfate. A second bacterium similar, if not identical, in its morphological, cultural, and physiological characters to *Th. thiooxidans* has been isolated repeatedly from the acid mine drainage of some bituminous coal mines. It is postulated that this latter or an unknown similar organism is involved in the oxidation of the sulfur and the sulfur compounds to sulfuric acid. The increasing demands for abatement of stream polution by acid mine drainage has intensified the efforts of many agencies to solve the problem. It is felt that the mine-sealing program has not given a complete solution and it is suggested that the study of the relation of certain microorganisms to the formation of the sulfuric acid in the mine might be a most profitable one.

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Reconnaissance Soil Survey Work in Japan

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THE RECONNAISSANCE SOIL SURVEY OF Japan now being conducted by American scientists is the first of its kind to be made of that country using modern survey methods for classifying and mapping soils in terms of their morphological features. Soil maps of Japan now available from Japanese sources have been made according to the old geological method of soil surveying similar to that used initially in the United States.

During the past 20 years Japan has produced only 80–85 per cent of her annual food requirements. Because of the food shortage there and in the world as a whole, the maintenance or increase of food production has now assumed particular importance. Since modern soil maps which could be used as an aid in maximizing Japan's food production were unavailable, the survey was undertaken.

The most important agricultural areas are being mapped first, particularly the larger plains and more nearly level regions. The hilly and mountainous sections are of little importance agriculturally. A preliminary field survey was made of Japan before any reconnaissance surveys were initiated. Reconnaissance soil surveys of the Kanto Plain area near Tokyo and the island of Kyushu have been completed (Table 1). Surveys in progress include the islands of Hokkaido and Shikoku, and the Osaka Plain on the main island of Honshu. A soil map (1:250,000) printed in color and a report similar in outline to that of the Soil Survey Division, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, is to be published for each area surveyed. Because of the nature of the survey, only associations of soils are shown on the soil maps.

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[1] Formerly Major, Air Corps, and head of the Soils and Fertilizer Branch, Agriculture Division, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Tokyo, Japan.

Several sources of data and information are used in preparing the map and report. Much of the information is obtained through field observation of the soils by experienced American soil surveyors and from Japanese soil and geological maps. Map information and soil data already gathered by Japanese scientists are being coordinated and interpreted in terms of modern soil concepts and nomenclature. Arrangements have been made with the Soils Departments of the Imperial Universities of Japan to make physical and chemical determinations on soil samples taken in the field during the course of the survey. Samples are also being sent to the Soil Survey Division, U. S. Department of Agriculture, for analysis.

TABLE 1

Soil group	Kanto Plain*		Kyushu†	
	Acres	Per cent of total area	Acres	Per cent of total area
Brown forest	2,241,551	28.14	777,431	8.51
Alluvial	1,605,317	20.16	981,531	10.75
Black forest	100,332	1.26	115,275	1.26
Half bog	75,647	0.95	0	0
Planosols	35,036	0.44	224,599	2.46
Red and yellow podzolic	0	0	193,689	2.12
Lithosols	691,975	8.69	1,829,257	20.03
Sands	73,258	0.92	34,621	0.38
Rough mountainous land	2,981,302	37.44	4,941,461	54.11
Barren volcanic rock	0	0	33,909	0.37
Water	159,258	2.00	0	0
Total	7,963,676	100.00	9,131,773	100.00

*About 33 per cent of the area is now being used for agricultural purposes.
†About 20 per cent of the area is now being used for agricultural purposes.

For many years Japanese soil scientists believed that the soils of the country did not fit into the prevailing scientific scheme of classification and, therefore, would not accept the modern concept of great climatic soil groups. While placing their greatest emphasis on geological effects on the formation of soils, they did admit that vegetation and climate exerted certain influences on soil formation processes. It is not surprising, however, that the Japanese did not readily accept modern soil survey methods, for even in the United States there existed certain areas where initially it was difficult to apply the modern pattern. As late as 1935, Marbut, in his *Soils of the United States* (see C. B. Hutchison's *California agriculture*. Berkeley: Univ. California Press, 1946), was unable to delineate in California representatives of the great soil groups of the world.

In 1937, however, an Outline Soil Map of Japan (1:5,000,000), prepared by Toyotaro Seki, of the Imperial Agricultural Experiment Station in Nishigahara, Tokyo Prefecture, was published in an article by L. G. Scheidl (*Mitteil. dtsch. Ges. Natur Volk.* Ost., Vol. 30, Pt. A). This map includes and recognizes the role of climate and vegetation in soil development, establishing the morphology of the soils themselves as the basis of classification. Detailed soil surveys of parts of Aomori and Gifu Prefectures were made by the Japanese using this classification scheme, the soil survey program having been curtailed during World War II. The Japanese are now being encouraged to activate their soil survey work as rapidly as possible. Whenever practicable, technical assistance in the reactivation of their soil survey program is being given by American soil scientists. In this connection, the published reconnaissance soil survey reports and maps of Japan will be made available to them.

Certain representatives of the major zonal and intrazonal soil groups of the world are now being identified in Japan (Table 1 and Fig. 1). It is being observed that profile characteristics are similar to those in the United States at comparable latitudes; it appears, however, that local topography and parent material, especially volcanic ash materials, exert more influence on the kinds of soils developed than does climate. When one considers the extremely rugged terrain and steep slopes that prevail over most of Japan, it is understandable why the Japanese, until recently, gave little consideration to climate and vegetation influences as important soil-forming factors. The many diastrophic movements that have occurred quite recently, geologically speaking, have naturally tended to maintain or increase the areas of rugged terrain and steep slopes, thereby continuing conditions conducive to the development of immature and young soils. The high rainfall generally prevalent in Japan helps to hinder the development of soil profiles by eroding weathered materials from the slopes. The constant changing of the topography, the continual removal of weathered materials to lower levels, the additions of volcanic ash, and the high rainfall have all combined to assure

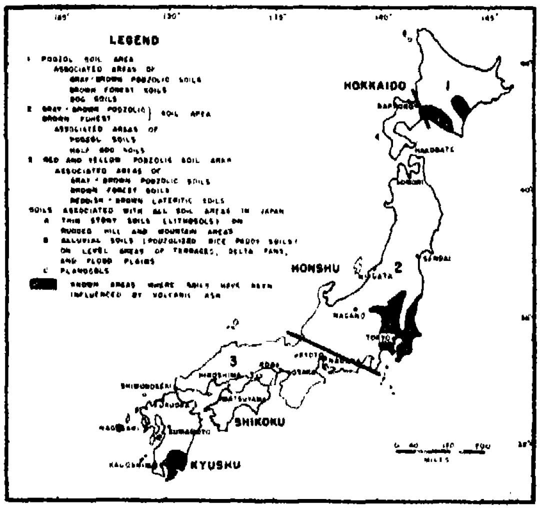
LEGEND
1 PODZOL SOIL AREA
ASSOCIATED AREAS OF
GRAY-BROWN PODZOLIC SOILS
BROWN FOREST SOILS
BOG SOILS
2 GRAY-BROWN PODZOLIC } SOIL AREA
BROWN FOREST
ASSOCIATED AREAS OF
PODZOL SOILS
HALF BOG SOILS
3 RED AND YELLOW PODZOLIC SOIL AREA
ASSOCIATED AREAS OF
GRAY-BROWN PODZOLIC SOILS
BROWN FOREST SOILS
REDDISH-BROWN LATERITIC SOILS
SOILS ASSOCIATED WITH ALL SOIL AREAS IN JAPAN
A THIN STONY SOILS (LITHOSOLS) ON RUGGED HILL AND MOUNTAIN AREAS
B ALLUVIAL SOILS (PODZOLIZED RICE PADDY SOILS) ON LEVEL AREAS OF TERRACES, DELTA FANS, AND FLOOD PLAINS
C PLANOSOLS
SHOWN AREAS WHERE SOILS HAVE BEEN INFLUENCED BY VOLCANIC ASH
HOKKAIDO
1
SAPPORO
HAKODATE
AOMORI
SENDAI
HONSHU
NIIGATA
2
NAGANO
TOKYO
KYOTO
3
KOBE
OSAKA
HIROSHIMA
SHIMONOSEKI
MATSUYAMA
SHIKOKU
NAGASAKI
KUMAMOTO
KAGOSHIMA
KYUSHU
MILES

FIG. 1. Generalized soil map of Japan.

that materials in a given locality would not be given time to develop mature profile characteristics.

The most important soils of Japan, which support the bulk of the population, are the alluvial soils developed in the lowlands. On these, paddy or irrigated rice is grown during the summer, and in southern Japan (Fig. 2) during the winter months these soils are also cropped to wheat or barley. Many of the important agricultural soils are developed on volcanic ash (Fig. 1). Brown forest and black forest soils,[2] derived principally from volcanic ash materials, are important upland soils used for crop production purposes. Since these are especially low in available phosphorus, they are comparatively low in inherent fertility. They are physically well suited to growing small grains, white and sweet potatoes, vegetables, mulberry, upland rice, tree fruits, tea, tobacco, and other nonirrigated crops.

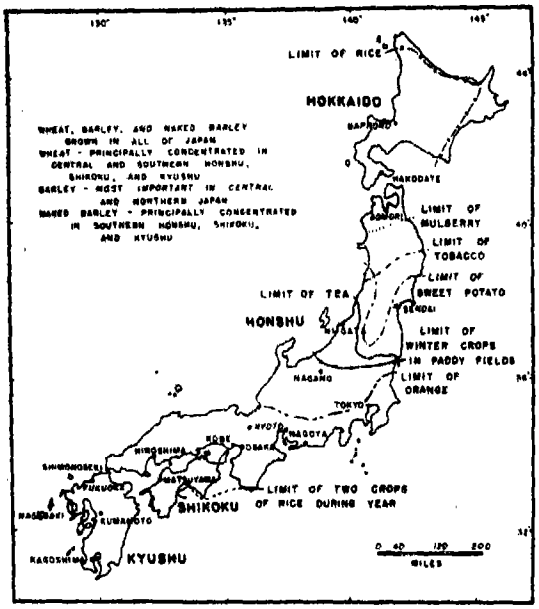
130°
135°
140°
145°
45°
40°
35°
LIMIT OF RICE
HOKKAIDO
SAPPORO
HAKODATE
WHEAT, BARLEY, AND NAKED BARLEY GROWN IN ALL OF JAPAN
WHEAT - PRINCIPALLY CONCENTRATED IN CENTRAL AND SOUTHERN HONSHU, SHIKOKU, AND KYUSHU
BARLEY - MOST IMPORTANT IN CENTRAL AND NORTHERN JAPAN
NAKED BARLEY - PRINCIPALLY CONCENTRATED IN SOUTHERN HONSHU, SHIKOKU, AND KYUSHU
AOMORI
LIMIT OF MULBERRY
LIMIT OF TOBACCO
LIMIT OF SWEET POTATO
LIMIT OF TEA
SENDAI
HONSHU
NIIGATA
LIMIT OF WINTER CROPS IN PADDY FIELDS
NAGANO
LIMIT OF ORANGE
TOKYO
KYOTO
NAGOYA
KOBE
OSAKA
HIROSHIMA
SHIMONOSEKI
MATSUYAMA
FUKUOKA
LIMIT OF TWO CROPS OF RICE DURING YEAR
SHIKOKU
NAGASAKI
KUMAMOTO
KAGOSHIMA
KYUSHU
0 40 120 200
MILES

FIG. 2. Northern limits of a number of crops in Japan.

In many of the red and yellow podzolic soil areas (Fig. 1), because the demand for cropland is so great, a large number of the steep slopes poorly suited to agriculture are terraced and cropped. The crops grown are wheat, barley, upland rice, white and sweet potatoes, vegetables, and, in many places on southern slopes facing the sea, citrus fruits are grown. Podzol soils occur at the higher elevations in Hokkaido and northern Honshu, but they are more widespread in the former area than in the latter. In these areas they are associated with coniferous vegetation. Most of the gray-brown podzolic soils, which are developed in the hill and mountain areas of the podzols (Fig. 1), are forested, but where the soil is deep enough, farmers have either terraced them or planted the row crops up and down hill without the benefit of terraces. In the unterraced fields, soil erosion is quite severe. White potatoes, tree fruits, vegetables, small grains (wheat, barley, oats), corn, and hay are the upland crops grown on these soils. Lithosols, which are found on the perimeter of the undulating and rolling plains adjacent to mountains and in upland areas in mountainous regions, are not well suited to crop production and are mostly in forest vegetation.

For maximum crop yields, most of the soils of Japan require heavy fertilization and liming. Fertilizers are of real importance because of the intensive agriculture and because the scarcity of agricultural land makes it important to secure high yields from every crop grown. The preponderance of hilly and mountainous terrain sets definite limits to the cultivated area and explains why no more than 15,000,000 acres, or 16 per cent of the total area of Japan, is cultivated.

Locally produced materials, such as compost, night soil (human excrement), green manure, and wood and straw ashes are used extensively as fertilizer materials. Bean cake and fish fertilizers have been applied to the soil in the past, but recently these materials have been used largely for food purposes. Large quantities of commercial fertilizers, particularly ammonium sulfate and superphosphate, have been employed. Their use was curtailed during World War II because production of nitrogenous fertilizer was retarded, while production of phosphatic fertilizer was dependent on imports of phosphate rock. When world consumption (1935–37) of commercial fertilizers used by each country is considered, Japan ranked third for nitrogenous fertilizers and sixth for phosphatic and potassic fertilizers (K. G. Clark and M. S. Sherman. *Prewar world production and consumption of plant foods in fertilizers*. U. S. Dept. Agric. Misc. Publ. 593, 1946). Yet that country ranked nineteenth in the world distribution of arable lands.

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[2] The names "brown forest" and "black forest" were originally given to the soil groups so designated by Japanese and German soil scientists and some question exists as to the correctness of this application. The brown forest soils do not have all of the profile characteristics normally associated with brown forest soils, being acidic in nature and slightly podzolized. Consideration is now being given to assigning a new great soil group name to these soils.

NEWS
and Notes

Large-scale extraction of fossils from limestone rock by an etching process now in progress at the Smithsonian Institution is expected to yield over 1,000,000 new specimens for invertebrate collections. The rock bearing the fossils is immersed in muriatic acid in large, acid-resistant vats, the limestone being thus dissolved to yield the silicified fossils intact. Over the last 8 years more than 12 tons of limestone have been brought to Washington, D. C., from the rich Permian deposits of West Texas. It is estimated that it will require 3 years to secure the fossils from the 8 tons of rock remaining to be processed, but at the end of this time the Smithsonian paleontologists expect to find 700–1,000 species, many of which will be new.

According to G. A. Cooper, who is directing the classification of brachiopods, an estimated 50 per cent of all the fossil brachiopods recovered will be new specimens. This class, which is distinguished by its inequivalve and bilaterally symmetrical character, appeared first during the Devonian period, reaching its highest differentiation and greatest distribution during the Permian. At the present time there are only about 200 known species and 60 known genera, distributed widely over marine areas, but abundantly in only a few.

About People

Maximilian Philip, chairman, Department of Mathematics, City College of New York, retired September 1 after 45 years in that Department. Prof. Philip is succeeded by **Warren G. Hubert**, who has served on the City College staff since 1912.

Jesse W. Huckert, formerly associate editor of *Product Engineering*, has been appointed to the staff of the Department of Mechanical Engineering, Ohio State University, and will assume his duties there October 1.

E. L. Porter, professor of physiology, University of Texas Medical Branch, Galveston, is spending several months with **H. S. Liddell**, professor of psychology, Cornell University, and director, Cornell Behavior Farm, where both will continue their joint studies on chronic experimental neuroses in animals.

D. P. Costello, professor of zoology, University of North Carolina, has been appointed chairman, Department of Zoology. **R. E. Coker**, former chairman, has resigned to continue as Kenan professor of zoology for teaching and research.

Carleton Shugg, general manager of Todd Shipyards Corporation in charge of New York Harbor work, has been appointed manager, Hanford Directed Operations, U. S. Atomic Energy Commission, with offices at Richland, Washington.

Among those retiring from the staff of Ohio State University this summer with the rank of professor emeritus were: **John F. Cunningham**, dean, College of Agriculture; **Clyde T. Morris**, chairman, Department of Civil Engineering; **Leonard W. Goss**, chairman, Department of Veterinary Pathology; and **Carl W. Gay**, professor, Department of Animal Husbandry.

Vernon E. Krahl, formerly of the Department of Anatomy, Wayne University College of Medicine, has been appointed associate professor, Department of Gross Anatomy, University of Maryland School of Medicine, Baltimore.

R. Blackwell Smith, Jr., formerly of the Pharmacological Department, Food and Drug Administration, Washington, D. C., on July 1 assumed the deanship of the School of Pharmacy, Medical College of Virginia, Richmond.

David W. Bishop, formerly assistant professor of zoology, University of Colorado, and visiting lecturer, University of Illinois, during the current summer session, has been appointed to the staff of the Department of Zoology, University of Illinois.

Robert H. Cotton, director, Plymouth Division, National Research Corporation, has resigned to become supervisory chemist at the Citrus Experiment Station, University of Florida, Lake Alfred.

Curt Stern has been appointed professor of zoology at the University of California, Berkeley, and **William E. Berg** and **Oliver P. Pearson** have been made instructors in the Department.

Chester A. Darling, retired professor of biology, has been appointed acting president of Allegheny College, Meadville, Pennsylvania, and will serve until a permanent head is selected to succeed John R. Schultz, 14th president of the College, who died August 11.

Solon W. Stone, teaching fellow at Harvard University, has been appointed instructor in geology at Trinity College, Hartford, Connecticut.

Harold D. Webb, one of the scientists who established radar contact with the moon in January 1946, has been appointed assistant professor of electrical engineering in the University of Illinois College of Engineering. Since 1942 Dr. Webb has been employed at the Army Signal Corps, Belmar, New Jersey.

Walter L. Stutz, chief of the Engineering Instruments and Mechanical Appliances Section since 1928, has retired from the National Bureau of Standards after 35 years service. As chief of the Section, Dr. Stutz has been principally concerned with the direction of testing activities for other government agencies, including devices relating to flood control, power development, irrigation, and soil conservation.

Arthur Dorne and **Joseph Margolin**, formerly of the Antenna Design Section of the Airborne Instruments Laboratory, Mineola, New York, have established an antenna consulting firm—Dorne and Margolin, Antenna Consultants—effective on September 1, with offices temporarily located at 126 North Ocean Avenue, Freeport, Long Island, New York. While at the Airborne Instruments Laboratory, the two men were largely concerned with the faired-in, dragless antenna designing groups.

T. G. Yuncker, head, Botany Department, DePauw University, and during 1947 a visiting research professor at the University of Illinois, returned to DePauw late in August, having brought his studies of the Piperaceae to a close.

Grant W. Smith has resigned as research chemist and supervisor, Department of Polymerization Research, B. F. Goodrich Company, Akron, Ohio, to become professor and head, Department of Chemistry, University of North Dakota, Grand Forks.

John P. Buwalda, professor of geology, retired as chairman of the Division of Geology, California Institute of Technology, on July 1, in order to complete a number of research projects in structural geology upon which he has been working for some time. He will continue as professor in the Division. **Chester Stock,** professor of paleontology, succeeded Dr. Buwalda as head of the Division.

Visitors to U. S.

H. F. Frommurze, principal geologist of the Geological Survey of the Union of South Africa, is in the United States to study methods used by the U. S. Geological Survey in the exploration of ground water.

Yngve Andersson, research agricultural engineer at the Swedish Institute of Agricultural Engineering, Uppsala, recently visited Iowa State College, Ames, on a five-month tour of the United States. Dr. Andersson will investigate methods used in experiment stations, extension service methods, and use of machinery on farms.

Francis V. Groër, former professor of pediatrics and head, Pediatric Department, University of Lvov, now in Cracow (Poland), has been visiting the United States as Polish delegate to the Nutritional Committee of the Children's Save Found of the UNO and to the International Congress of Pediatrics, held recently in New York City. Dr. Groër was Theodore B. Sachs visiting professor at the University of Illinois, Chicago, and Hanna lecturer at Western Reserve University, Cleveland, in 1931.

Fellowships

The Institute of International Education has been requested by the Argentine National Cultural Commission to assist in selecting two U. S. graduate students who will receive fellowships from the Commission for 10 months study in Argentina. Laurence Duggan, director of the Institute, has announced that these fellowships, running from March 1 to December 31, 1948, will provide round-trip travel plus about $1,250. Applicants must be research workers of recognized standing in the arts, humanities, natural sciences, or social sciences; their fellowship work must be of positive benefit to the cultural development of the U. S. and Argentina; they must have a working knowledge of Spanish; and they must be between 25 and 45. Details and forms may be obtained from the Institute at 2 West 45th Street, New York 27. The closing date is October 31.

The Julius Rosenwald Fund is offering fellowships to average about $2,000 each to Negroes in any part of the United States, and to white Southerners who wish to work on some problem distinctive to the South and who expect to make their careers in the South. The fellowships are open to men and women between the ages of 24 and 35 who have completed their general college or professional course before making application. The term of the fellowship will be for one year, and grants will not be awarded for a term of less than six months. Applicants are not restricted to any special subject or activity. This is the last year that Rosenwald Fellowships will be available, since the Fund is closing its work next June. The closing date for applications is January 1, 1948. Application blanks may be secured from Mrs. Hilde Reitzes, Committee on Fellowships, Julius Rosenwald Fund, 4901 Ellis Avenue, Chicago 15, Illinois.

Grants and Awards

The Gold Medal of the American Society for Metals will be awarded in October to **C. H. Mathewson,** professor of metallurgy, Yale University. Dr. Mathewson, who is known for his work on constitution of alloys, crystallography, and recrystallization of metals, receives the medal "for outstanding metallurgical knowledge and great versatility in the application of science to the metal industry, as well as exceptional ability in the diagnosis and solution of diversified metallurgical problems."

The Inter-American Institute of Agricultural Sciences at Turrialba, Costa Rica, has recently received several grants. The Standard Oil Development Company has transferred the sum of $9,500 as the first of a series of annual payments to meet the cost of fellowships to provide for researches and investigations on the more economical and more efficient production of tropical crops of major importance, with particular reference to the application of chemical petroleum by-products for the destruction of weeds and also for the control of growth of certain plants of economic value. Standard Oil will also meet the expense of a visiting agricultural scientist, Ora Smith, Cornell University, who will spend three months a year at the Institute, outlining and directing the work of the Fellows. The American Coca Research Committee, Washington, D. C., has transferred $50,000 to the Institute as a contribution to the cost of conducting an intensive research that will reduce the existing high percentage of crop failures and develop new techniques in the planting and cultivation of cacao. The American International Association for Economic and Social Development has granted the Institute $158,000 to permit an extension of research and educational facilities there, particularly in the Animal Industry Department. The grant will also permit Institute scientists to train students and farmers selected to become teachers and demonstrators on the staff of the Association.

The Inter-American Institute of Agricultural Sciences, whose executive offices are in the Pan American Union Building, Washington, D. C., operates on the basis of a Convention by which the governments of the American republics have agreed to recognize the permanent status of the Institute as an inter-American entity. Its purpose is to encourage and advance the development of agricultural sciences in the American republics through research, teaching, and extension activities in the theory and practice of agriculture and related fields. The Institute is divided into four major departments, Plant Industry, Animal Industry, Agricultural Engineering, and Agricultural Economics and Rural Welfare, and is at present engaged in research work on important tropical industrial and food plants as well as animal industry.

The Institute is governed by a Board of Directors, made up of one representative from each American Republic, whose chairman is Antonio Rocha, of Colombia. Members of the Administrative Committee include: H. Harold Hume, provost, College of Agriculture, University of Florida; Robert Earle Buchanan, director, Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts; and Luis Cruz, San José, Costa Rica. Director of the Institute is Ralph H. Allee, Costa Rica, and secretary is José L. Colom, Washington, D. C.

Research looking toward the decrease in deaths from gangrene diseases will be continued by the Department of Bacteriology, Indiana University, as the result of an annual grant of $13,860 from the National Institute of Health. The research, initiated last year, is being conducted by L. S. McClung, head of the Department, in cooperation with Harry G. Day, chemist.

Colleges and Universities

The Department of Anthropology, University of Colorado, has appointed **Robert H. Lister,** Harvard University, to its staff. **Robert F. Burgh,** an archaeologist, has been appointed assistant to the director.

The Biology Department, University of Notre Dame, has recently made several staff changes and appointments. **Donald J. Plunkett,** associate professor of biology, has been named assistant head of the Department; **John A. Jump** has been promoted to associate professor of botany; **Noe Higinbotham,** assistant professor of botany, has been granted leave of absence to participate in radiobiology research at the Argonne National Laboratory, Chicago; **Albert L. Delisle,** formerly director, Botanical Division, Universidad Nacional Facultad de Agronomia, Medellin, Columbia, has been appointed associate professor of botany and curator of the University's Herbarium; **Louis E. DeLanney,** San Jose Teachers College, has been named assistant professor of embryology; and **Edward O. Dodson,** formerly of Dominican College of San Rafael, will become instructor of vertebrate zoology.

The Department of Zoology and Entomology, University of Tennessee, has added three new assistant professors to its staff during the past academic year: **John M. Carpenter,** of the University of Texas; **Joseph C. Howell,** Cornell University; and **James T. Tanner,** Cornell University.

The Department of Physics, Illinois Institute of Technology, has announced the promotion of **W. E. Bennett** from associate professor to professor, **R. G. Nuckolls** from assistant to associate professor, and **A. G. Meister** from instructor to assistant professor, and the appointment of **F. F. Cleveland** and **F. L. Yost** as professor and associate professor, respectively.

The University of Miami, Florida, has announced the following additions and promotions involving members of the Department of Zoology: **Jay F. W. Pearson,** to vice-president of the University; **E. Morton Miller,** to chairman of the Department; **Julian C. Corrington** and **Henry F. Strohecker,** to professors. New associate professors are **Lauren C. Gilman** and **Luis René Rivas,** and **Vernon Gregory** has been named instructor. **F. G. W. Smith** is director of the Marine Laboratory.

Boston College has made the following appointments in its Department of Chemistry: **Samuel Glasstone,** wartime consultant in electrochemistry, Zenith Radio Corporation, and formerly professor of chemistry, University of Oklahoma, professor; **Andre de Béthune,** Massachusetts Institute of Technology, and **Timothy McCarthy,** Massachusetts State College, Devens, assistant professors; and **Albert F. McGuinn,** S. J., reappointed head of the Department upon the resignation of **John K. Rouleau,** who has held this position for the past year.

At Kent State University the Physical Science Department has been divided into the Departments of Chemistry and Physics. **Will Thompson,** formerly head of the combined departments, is now head of the Department of Chemistry, and **G. K. Schoepfle,** of the Department of Physics.

The University of Cincinnati Research Foundation, under a $67,000 contract with the U. S. Army Air Forces, has begun a study of atmospheric conditions to discover the nature and properties of haze. Boris Podolsky, associate professor of mathematical physics, will direct the work, assisted by Roy J. Kennedy, experimental physicist, U. S. Bureau of Standards.

The Ohio State University Research Foundation is at present engaged in a two-year research project under contract with the Army Signal Corps to investigate the effects of arctic temperatures on electric batteries. Data collected from experiments, directed toward finding the most practicable solvent for use in batteries at temperatures reaching $-100°$ F., have shown water solutions of alcohol, hydrochloric acid, fluoroboric acid, and perchloric acid to be most satisfactory. Studies on electrolytes were then made to discover the best conducting medium for reducing the high internal resistance of the battery under extremely low temperatures. The investigators are now attempting to determine the most suitable electrochemical couple, or proper combination of chemicals necessary to produce electricity.

A planned program of dental research which will include studies on the bacteriological and biochemical aspects of dental caries, with special emphasis on the possible importance of proteolytic bacteria in the causation of caries, is to be undertaken at the University of Rochester School of Medicine and Dentistry under a contract with the Army Medical Research and Development Board. The investigation, to be conducted in the Departments of Bacteriology and Dental Research under the direction of George P. Berry and J. E. Gilda, will be carried on in close cooperation with Basil G. Bibby, director of the Eastman Dental Dispensary. One or more selected Dental Corps officers will be assigned to participate in this and subsequent studies and to do graduate work in the biological sciences. Capt. George W. Burnett, DC, is the first officer to be so assigned.

Industrial Laboratories

Eastman Kodak Company has recently named **Cyril J. Staud** new director of the Kodak Research Laboratory and **John A. Leermakers** assistant director and head of the photographic theory department. **C. E. K. Mees,** director of the laboratories since 1912, will continue to serve as vice-president in charge of research. Dr. Staud, an organic chemist, has been serving as acting director since 1943 in the absence of Dr. Mees, and Dr. Leermakers was formerly technical assistant to the director. Other appointments include: **Samuel W. Davidson,** business manager; **Walter Clark,** head of the black-and-white photography department; **W. O. Kenyon,** head of the high polymer department; and **H. C. Yutzy,** head of the emulsion research department.

M. K. Ryan, Jr., manager of the technical service section, Acetate Division, Du Pont Company, has been made manager of the fabric development section of the Division, succeeding **Carl I. Taber,** who was recently transferred to the Nylon Division. Mr. Ryan's position will be assumed by **G. S. Hooper,**

technical superintendent of the acetate yarn plant at Waynesboro, Virginia.

Clifford S. Leonard, formerly assistant professor of pharmacology, College of Medicine, University of Vermont, has been appointed chief, Biological Division, Lakeside Laboratories, Inc., Milwaukee, Wisconsin.

W. Keith McAfee has been elected chairman of the Board of Universal Sanitary Manufacturing Company, New Castle, Pennsylvania. He will also continue to give his personal attention to engineering, research, and development.

Almon G. Hovey, formerly in charge of the New Chemicals Development Section, is now head of the Technical Sales Service, Chemical Division, General Mills, Inc., Minneapolis.

Albert B. Scott, director of research and development, Norwich Pharmacal Company, and director, Eaton Laboratories, has recently resigned. Dr. Scott, who is credited with the discovery and development of Furacin, has been with the Norwich Company since 1939.

Warren H. Goss, assistant to the director, and head, Market and Product Development, Northern Regional Research Laboratory, U. S. Department of Agriculture, Peoria, Illinois, has been appointed associate director, Research and Products Development Department, Pillsbury Mills, Inc., Minneapolis.

W. H. Stark, director of research, Joseph E. Seagram & Sons, Inc., Louisville, Kentucky, has been appointed general manager, Vickers-Vulcan Process Engineering Company, Ltd., Montreal, Canada. Dr. Stark is succeeded as director of research by **Paul J. Kolachov,** previously technical counselor.

Gale Boxill, who was recently graduated from Washington-Lee University, has joined the Pharmacology Department, Wm. S. Merrell Company, Cincinnati, Ohio.

Donald A. Quarles, director of apparatus development, Bell Telephone Laboratories, has recently been elected a vice-president. He has been associated with the Bell System since 1919.

G. F. D'Alelio, manager, High Polymer Research Laboratory, Industrial Rayon Corporation of Cleveland, has been appointed assistant director of research, Koppers Company, Inc., Pittsburgh.

H. B. H. Cooper, divisional engineer associated with the Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, has been appointed assistant manager of the Development Department.

Meetings

A symposium on refractory oxides has been arranged by the Refractories Division, Harbison-Walker Refractories Company, for October 10–11 at the Bedford Springs Hotel, Bedford, Pennsylvania. The program is open to all those interested in this field. The technical session, to be held on the afternoon of October 10, will include "Introduction to the Study of the Refractory Oxides," Raymond E. Birch, Harbison-Walker; "Simple Oxide Porcelains for Jet Planes and Projectiles," R. F. Geller, National Bureau of Standards; "Properties and Uses of Mullite and Pure Alumina Refractories," G. B. Remmey, Richard C. Remmey Sons Company; "Zircon and Zirconia Refractories," W. J. Baldwin, Titanium Alloy Manufacturing Company; and "Carbon as a Refractory Material," F. B. Thatcher, Great Lakes Carbon Corporation. Further information may be obtained from Collin Hyde, Harbison-Walker Refractories Company, Hays Laboratory, Pittsburgh 7, Pennsylvania.

The Highway Research Board will hold its 27th annual meeting December 2–5 at the building of the National Academy of Sciences and National Research Council, 2101 Constitution Avenue, Washington, D. C. During the week of the meeting the 6 Departments of the Board—Economics, Finance, and Administration; Design; Materials and Construction; Maintenance; Traffic and Operations; and Soils—will present and discuss important phases of highway technical development. Many of their 65 project committees will also meet.

The 6th Saranac Symposium will be held at The Saranac Laboratory, Saranac Lake, New York, September 29–October 3, inclusive. The primary topic for discussion concerns beryllium, which is assuming great importance in several lines of manufacture, with Monday devoted to its industrial phases and Tuesday, Wednesday, and Thursday morning to its medical, toxicological, and experimental aspects. Thursday afternoon is reserved for the clinical, chemical, and engineering discussions of Shaver's disease, and the agenda for the final sessions on Friday comprise the current viewpoints on workmen's compensation for pulmonary and other occupational disease. Participants will include representatives of industrial, labor, and insurance groups, universities and research foundations, national and state health agencies and labor departments, as well as state compensation boards.

The New York Section, American Association of Cereal Chemists, opens its 1947–48 season on October 7 with a combined meeting with the New York group of the American Society of Brewing Chemists at the Building Trades Employers Association club rooms, 2 Park Avenue. Reservations for the dinner at 6:30 P. M. must be made with Lawrence Atkin, Wallerstein Laboratories, 180 Madison Avenue, New York 16. Aage Lund, chief chemist of the Tuborg breweries, Copenhagen, and co-author of the 1939 edition of Jorgensen's *Micro-organisms and fermentation,* will speak on "Biological Control and Microorganisms in Breweries." Nonmembers interested in the fermentation industries are cordially invited to make reservations for the dinner or to attend the lecture, which will begin about 8 P. M.

The third annual meeting of the National Conference on Industrial Hydraulics will be held October 16–17, at the Hotel Continental, Chicago. The Conference is sponsored by Armour Research Foundation and the Graduate School, Illinois Institute of Technology, in cooperation with the Western Society of Engineers and the Chicago sections of the Society of Automotive Engineers, American Society of Civil Engineers, and the American Society of Mechanical Engineers. The following program has been planned: October 16, "Fundamentals of Hydraulic Governor Operation," G. Forrest Drake, Woodward Governor Company, Rockford, Illinois; "Hydraulic Circuits of Industrial Process Controls," H. Ziebolz, Askania Regulator Company, Chicago; "Fundamental Aspects of Cavitation," Hunter Rouse, Iowa Institute of Hydraulic Research, State University of Iowa; "Cavitation, the Limiting Factor in Marine Propulsion," Karl E. Schoenherr, College of Engineering, University of Notre Dame; "Cavitation in Centrifugal Pumps—Some of the Less Well-Known Factors," R. M. Watson, Worthington Pump and Machinery Corporation, Harrison, New Jersey; October 17, "Hydrokinetic Transmissions," W. F. Shurts, Twin Disc Clutch Company, Rockford, Illinois; "Torque Converters: Making Inefficiency Pay Dividends," Robert Lapsley, Clark Equipment Company, Buchanan, Michigan; "Some Recent Developments in Hydraulic Transmissions," R. H. Hensleigh, Consulting Engineer, Detroit, Michigan; "Variable Speed Hydraulic Power Transmission," James Robinson, Vickers, Inc., Detroit, Michigan; "Hydraulic Fluids and Their Applications," James I. Clower, University of Delaware; "Development of Hydraulic Seals," W. W. Hagerty, University of Michigan; and "Postwar Aspects and Problems of Engineering Research," Boris A. Bakhmeteff, Columbia University. Further information may be obtained from Le Van Griffis, Armour Research Foundation, Technology Center, Chicago 16, Illinois.

The Physical Society and the **Institute of Physics of England** are jointly arranging a series of meetings and other functions to take place September 25-26, 1947 in London, to mark the 50th anniversary of the discovery of the electron by Sir J. J. Thomson. A special exhibition to demonstrate the tremendous influence such an advance in pure physics may have on the life of the community will be held at the Science Museum, South Kensington, remaining open to the public for several weeks.

The National Committee for Mental Hygiene will meet at the Hotel Pennsylvania, New York City, November 12-13. The annual program will be devoted to mental hygiene issues in "Preparing for World Citizenship," as suggested by the preamble to the UNESCO constitution. The same theme has been chosen for the International Congress on Mental Hygiene to be held in London in August 1948. An examination of the International Bill of Rights in relation to mental hygiene will be followed by a discussion of the mental health potentialities of the World Federation for Mental Health, a voluntary agency, and the World Health Organization, a public agency of the UN for international cooperation. The annual luncheon meeting on November 13 will feature the presentation of the Lasker Award for the year's most significant contribution to popular adult education, especially in parent-child relationships, and an address on the responsibilities and opportunities of citizens and mental hygiene organizations in the states in terms of immediate issues to be met.

Elections

At the annual meeting of the Mt. Desert Island Biological Laboratory, Salsbury Cove, Maine, the following officers of the Corporation were elected for 1947-48: Dwight E. Minnich, University of Minnesota, president; Wm. H. Cole, Rutgers University, vice-president; Roy P. Forster, Dartmouth College, secretary; John Whitcomb, Bar Harbor, treasurer; and Mrs. H. V. Neal, Salsbury Cove, clerk. Following the resignation of Roy Forster, who served 7 years as director, J. Wendell Burger, Trinity College, Hartford, Connecticut, was elected as the new director. In the reports of the officers it was noted that the Laboratory was having one of its most successful seasons. Thirty-seven workers and their assistants were in attendance.

The American Academy of Dental Medicine, at its first annual meeting in June, awarded an honorary membership to Walter Henry Wright, dean, New York University College of Dentistry. Officers of the Academy elected for the coming year are: Sidney Sorrin, president; J. Lewis Blass, president-elect; William M. Greenhut, secretary; George Bruns, treasurer; and Allan N. Arvins, editor.

NRC News

The Radio Corporation of America Fellowship Board of the NRC announces the first series of awards to five young scientists. These fellowships for the academic year 1947-48 provide for advanced graduate study and research in the broad field of electronics. Recipients of the fellowships are: Arnold S. Epstein, B.S. in electrical engineering, Lehigh University, for graduate study at the University of Pennsylvania with special reference to silenium and other rectifiers as variable capacitors; Willis W. Harman, B.S. in electrical engineering, University of Washington, for graduate study at Stanford University on the use of microwaves in certain cavity oscillators; Arnold R. Moore, B.S. in chemistry, Polytechnic Institute of Brooklyn, for graduate study at Cornell University on electronic properties of semiconductors; Sol Raboy, A.B. in physics, Brooklyn College, for graduate study at Carnegie Institute of Technology on the properties of semiconductors and their use as crystal counters; and H. Gunther Rudenberg, S.B. and M.A. in physics, Harvard University, for continuation of graduate study at Harvard University on the operation and design of wide-band pulse amplifiers.

These fellowships have been made possible by a grant to the NRC from the Radio Corporation of America, Inc., for the purpose of increasing the number of trained scientific personnel and for the furtherance of electronics and closely related fields. The selection of the fellows and the administration of the fellowship program are under the direction of the RCA Fellowship Board, the members of which are Frederick E. Terman, chairman; C. C. Chambers, W. G. Dow, Frederick M. Feiker, R. Clifton Gibbs, I. I. Rabi, and Lloyd P. Smith.

Applications for awards for the academic year 1948-49 must be filed before February 1. Stipends will be from $1,600 to $2,100 a year, and an added amount, not to exceed $600, may be provided annually to the institutions to which the fellow is assigned for tuition or necessary equipment.

Further information concerning these fellowships and application blanks may be secured from the Secretary of the RCA Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Recent Deaths

John L. Ulrich, 69, physiologist and former faculty member at the Johns Hopkins Medical School, the University of Maryland, Catholic University, and head of the Physiology Department, New York Homeopathic Medical College 1928-32, died in Baltimore on August 8.

Tiffany J. Williams, 49, professor of obstetrics and gynecology, University of Virginia, died August 19 in Charlottsville, Virginia.

Frederick M. Pederson, 78, formerly associate professor of mathematics, City College of New York, died August 20 at Hewletts Landing, Lake George, New York.

Willard L. Severinghaus, 65, a member of the physics staff at Columbia University from 1907 until his retirement in 1941, died August 28 in New York City after a long illness.

William E. Wickenden, 64, president of Case Institute of Technology since 1929, died of a heart attack at his summer home in Jaffrey, New Hampshire, on August 31, the day of his retirement from the presidency.

Shuichi Kusaka, 31, assistant professor of physics, Princeton University, was drowned at Beach Haven, New Jersey, on August 31.

Rudolf W. Glaser, 59, entomologist and zoologist who for the past 27 years had been associated with the Rockefeller Institute for Medical Research, died on September 4 in Princeton, New Jersey.

John Herr Musser, 64, professor of medicine at Tulane University since 1925, died September 5 in New Orleans.

Robert G. Green, 52, professor of bacteriology, University of Minnesota, since 1929, died September 6 at his home in Minneapolis.

Frank O. Ellenwood, 68, John Edson Sweet professor of engineering, Cornell University, and an authority on steam-power plants, died in Strong Memorial Hospital, Rochester, New York, on September 7.

James S. Plant, 57, director of the Essex County Juvenile Clinic, Newark, New Jersey, since 1923, died September 7 at his home in South Orange, New Jersey, following a heart attack.

Rear-Admiral James C. Pryor, 76, onetime head, Department of Hygiene, Naval Medical School, and professor of preventive medicine, George Washington University, died September 8 in the Naval Hospital, Brooklyn, after a long illness.

Magel C. Wilder, 49, assistant professor of biology, Brown University, died September 8 at her summer home in Hamilton, Rhode Island.

Soup fin sharks and ling cod will provide the raw materials for a new vitamin-concentrating plant now being built for Vitamin Sales Corporation of South Africa at Simonstown, about 23 miles from Cape Town. Oil from the livers of these fish contains high concentrations of Vitamin A. The technique called the Solexol Process, developed by the M. W. Kellogg Company, chemical engineers of New York, will be employed. By this processing technique over 90 per cent of the original Vitamin A and D content of a crude fish oil is recovered in the concentrate. In its location close to abundant raw materials, its use of this process, and with a ready market for its various products, the Solexol vitamin unit, first of its kind in the world, is expected to set a pattern for future marine oil processing plants.

The fall campaign of the New York University-Bellevue Medical Center Fund will be officially inaugurated at a dinner on September 30 at the Waldorf-Astoria Hotel to be attended by over 1,500 leaders in medicine and industry. The principal speaker will be Frank W. Abrams, chairman of the Board, Standard Oil Company of New Jersey. In a discussion of "Medicine's New Role in Industry" Harry Woodburn Chase, chancellor, New York University, Robert Kehoe, director, Kettering Laboratory, Cincinnati, and Howard A. Rusk, chairman of the University's Department of Rehabilitation, will complete the list of speakers.

Staticin Caronamide, a new drug inhibiting the renal tubular excretion of penicillin and elevating the concentration of penicillin in plasma from two to seven times, has been reported in the August issue of *The American Journal of Medicine*. The clinical tests were conducted at the Pennsylvania Hospital, Philadelphia, by Christopher C. Shaw, William P. Boger, and J. William Crosson, Medical Research Division, Sharp & Dohme, Inc., and Walter W. Kemp, William S. M. Ling, and Garfield G. Duncan, Department of Medicine, The Pennsylvania Hospital. The results of the work have indicated that the most satisfactory administration of the new drug is by mouth every three hours. The Staticin-penicillin therapy is expected to be of greatest value in combating subacute bacterial endocarditis and osteomyelitis.

The National Bureau of Standards has established a new Division of Building Technology, the nucleus of which consists of the following sections: structural engineering; fire protection; heating, ventilating, and air-conditioning; exterior and interior coverings; and codes and specifications. Research will be limited to physics, chemistry, and engineering. Much of the work to be carried on will be primarily for the benefit of other governmental agencies, although the results should be useful to the entire construction industry and it is intended that they shall be made available for this purpose.

Acta Chemica Scandinavica, a new journal in the field of chemistry, has been inaugurated by a group of Scandinavian scientists to further research done in the various Scandinavian countries and as a means of presenting new ideas and results to colleagues all over the world. The *Acta* aims thus also at a true international exchange of scientific information in the field of chemistry. All papers in the journal will be written in English, French, or German, and by Scandinavian scientists or others working in Scandinavian laboratories. It will appear 10 times per year, with a yearly volume totaling about 1,200 pages. Subscription rate is $8.50 plus postage. Orders should be addressed to Einar Munksgaard, Nørregade 6, Copenhagen, Denmark.

According to an announcement by Science Service, a second famous Harvard telescope has arrived in Torun, Poland, to become the chief instrument of the new observatory at the birthplace of Nicholas Copernicus. The 8-inch Draper telescope, which provided spectrograms of 100,000 northern stars for the late Annie Jump Cannon's 10-volume Draper catalogue of spectral classes, positions, and brightness, has been especially rehabilitated and equipped for a Polish program of research on star colors, temperatures, and chemical compositions.

Make Plans for—

American Institute of Electrical Engineers, Middle Eastern District Meeting, September 23-25, Dayton, Ohio.

American Public Health Association, October 6-10, Atlantic City, New Jersey.

American Academy of Ophthalmology and Otolaryngology, October 12-17, Chicago.

Society of Rheology, October 30-31, New York City.

American Association for the Advancement of Science, 114th Meeting, December 26-31, Chicago, Illinois.

COMMENTS
by Readers

Promotion and inhibition of growth may be produced by the same substance at different concentrations. Thimann (*Amer. J. Bot.*, 1937, **24**, 407-412; quoted from Meyer and Anderson. *Plant physiology*. New York: D. Van Nostrand, 1939. P. 580) suggests that "roots, buds, and stems all react in a comparable way to auxin, their growth being inhibited by relatively high and promoted by relatively low auxin concentrations, (and that this) is a possible explanation of the contrasting effects of auxins upon elongation in roots and aerial organs. Elongation of roots is favored only at very low concentrations; at all higher concentrations their growth is checked. Stems and coleoptiles show a similar behavior except that the optimum range of concentrations for elongation is much higher than for roots. The same concentrations of auxins which favor stem elongation result in a retardation of root elongation. . . . Briefly, therefore, whether auxin will exert an accelerating or an inhibiting effect upon growth seems to depend in part upon its concentration and in part upon the specific tissue involved."

Engard and Nakata (*Science*, May 30, pp. 577-580) present evidence for the presence in sugar cane of both a growth inhibitor and a growth promotor. In view of the above findings by Thimann and the more recent work by Eyster (*Plant Physiol.*, 1946, 21, 68-74) it seems very likely that the growth inhibitor and growth promotor in sugar cane are one and the same substance, producing differences in growth reactions because of differences in concentration. It is expected that acid will extract the growth substance more completely and more rapidly than water. The "acid fraction" may also owe some, or a dominant part, of its activity to the tartaric acid which was used for extraction purposes.

For comparative reasons it would be well to have a control using tartaric acid without any extract and another control using water without any extract. It would also be well to determine the *Avena* curvature produced by dilutions of the acid fraction. Dilutions of 10×, 100×, 1,000×, and 10,000× are suggested. Controls of these dilutions should also be run, and curvature determinations should be made. When this is done, there is a reasonable feeling of confidence that these isolated bits of evidence on auxins can be brought into agreement and perhaps result in a somewhat more complete picture of their true activity. (H. C. Eyster, *Charles F. Kettering Foundation, Yellow Springs, Ohio.*)

Description of centrifuge operations in terms of duration and speed is indeed inadequate, as Costello points out (*Science*, May 2, p. 474). It is unfortunate that correspondence directed toward correction of an incomplete system of description should contain a looseness of terminology which beclouds the issue. The formula, $c' = \frac{4\pi^2 n^2 r}{g}$, attributed by Costello to Heilbrunn, has been a part of the ordinary college course in general physics for decades, c' representing *not* "the centrifugal force in terms of gravity" but the ratio of the central acceleration (accompanying uniform circular motion) to the standard value of the acceleration due to gravity. More concisely, c' is the "centripetal acceleration in g's." It is not a force. (n is the number of revolutions per second; g, the standard acceleration due to gravity, in cm./sec.^{2}; and r, the distance, in centimeters, from the center of rotation to the material.)

The distinction between acceleration and force is far from trivial in centrifuging, for the separation of materials of different densities results from the difference in force. However, at a given speed and given radius from the axis of rotation, the acceleration is the same for all materials; the separation is produced by unbalance of forces arising from nonuniformity of density. It is therefore appropriate to describe the centrifuging in terms of c', but this is *centripetal acceleration*, not centrifugal force.

The emphasis given by Costello to the importance of estimating r with great care should be balanced by the remark that the percentage uncertainty in r may reasonably be twice that in n, since r occurs in the first power, while n occurs in the second power (Eshbach's *Handbook of engineering fundamentals*. New York: John Wiley, 1936). In this connection there would be considerable value in following the practice of specifying the percentage uncertainty in r and n in reporting centrifuge operations.

Finally, the formula should be reduced for convenience to the form

$$c' = 4.029 \times 10^{-2} n^2 r,$$

which is obtained by substituting numerical values for $4\pi^2$ and for the standard value of g. (Homer C. Knauss, *Raytheon Manufacturing Company, Waltham, Massachusetts.*)

In regard to the results of creatinine, hippurate, and inulin clearance estimations in rats by M. Friedman, Dicker and Heller (*Science*, August 8, p. 127) point out the possible inhibition by pain and anesthesia of urine flow in rats. We have recently conducted experiments on humans employing prolonged exposure (15 minutes) of one limb in an ice-water bath. Our results show a pronounced inhibition of urine excretion during, but particularly following, this experience. This phenomenon was associated with an increase in specific gravity of the urine and, in some instances, a change in protein excretion per minute. Experiments conducted under anesthesia (ethylene, cyclopropane, and various levels of spinal anesthesia) indicate that this pain stimulates the liberation of an antidiuretic hormone. The site of liberation is probably not within the immersed limb or within the kidney (since it was not present in high levels of spinal anesthesia if the lower extremity was used). Evidence supports its origin as being above the level of cervical 4. It was also our impression that the site of liberation was the posterior pituitary gland, although we were unable to show conclusively by bioassay on rats that the serum concentration of antidiuretic hormone increased in the patients so tested. (L. D. Odell and G. T. Aragon, *Department of Obstetrics and Gynecology, University of Chicago.*)

TECHNICAL PAPERS

Relative Sensitivity of Dormant and Germinating Seeds to 2,4-D

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It has been reported that seeds or seedlings can be killed by adding 2,4-D to soil or manure in which they occur (*1–4*). Later experiments at the U. S. Plant Industry Station have shown, however, that some seeds will eventually germinate, although the manure or soil in which they occur is treated with sufficient 2,4-D to be lethal for a period of several weeks. These results suggest that seeds of some species may be relatively insensitive to 2,4-D while dormant, and that those remaining dormant in soil or manure until the chemical is inactivated, may not be affected. Experiments described here were made to study the effect of treating dormant and germinating seeds with 2,4-D.

In the first experiment mustard seeds (variety Southern Giant Curled) were incubated on moist blotting paper in Petri dishes at 25°–27°C. until they had reached the desired stages of germination. Treatments were applied after the seeds had reached the following stages: I, unswollen seeds immediately after wetting; II, swollen seeds; III, seeds that had swollen and ruptured the coats; IV, seeds that had developed radicles 5 mm. in length. In treating, selected seeds or seedlings were immersed in the desired concentrations of aqueous solutions of the ammonium salt of 2,4-D (ammonium 2,4-dichlorophenoxyacetate) for definite periods of time. They were immediately washed for 15 seconds with running distilled water, blotted, and incubated. Untreated seeds were immersed for comparable periods in distilled water and designated controls. After both the controls and those treated with the salt had reached stage III, elongation of the radicles was recorded for the following 24-hour period. In the case of stage IV, elongation of the radicles was measured for a 24-hour period immediately after they had reached a length of 5 mm.

TABLE 1

Relative Root Elongation of Mustard Seedlings Treated for 30 Seconds With Concentrations of the Ammonium Salt of 2,4-D at 4 Stages of Development*

Concentrations (ppm)	Stage of development at treatment			
	I	II	III	IV
0	100	100	100	100
10				76
100	120	72	46	35
500	87	25	0	0
1,000	31	9	0	
2,000	12	7	0	

* Values represent percentages of elongation of radicles, the respective controls rated as 100 per cent.

Root growth of mustard seeds treated at stage I for *10 minutes* in a solution containing 500 ppm of the ammonium salt of 2,4-D was reduced 70 per cent. A *1-second* treatment of seeds in stage IV completely checked radicle elongation.

The sensitivity of mustard seeds was also determined by treating selected seeds in different stages of germination with a solution containing 500 ppm of the salt for a period of 30 seconds. On the basis of subsequent root growth, resting seeds were relatively insensitive to the salt. The seeds became more sensitive as they absorbed water and ruptured their coats. Seeds from which the radicles protruded were extremely sensitive to the salt solution (Table 1, Fig. 1).

Seeds of subterranean clover (*5*) (*Trifolium subterraneum*) germinate readily when subjected to a temperature of 20°C., on the other hand, they absorb water, yet remain dormant, when subjected to a temperature of 30°C. It is thus possible to plant the seeds in treated soil and hold them dormant for the period during which the acid remains active in soil (*4*). Once the 2,4-D has become inactivated, the seeds and soil can then be transferred to a temperature favorable for germination and the effect of the previous chemical treatment observed.

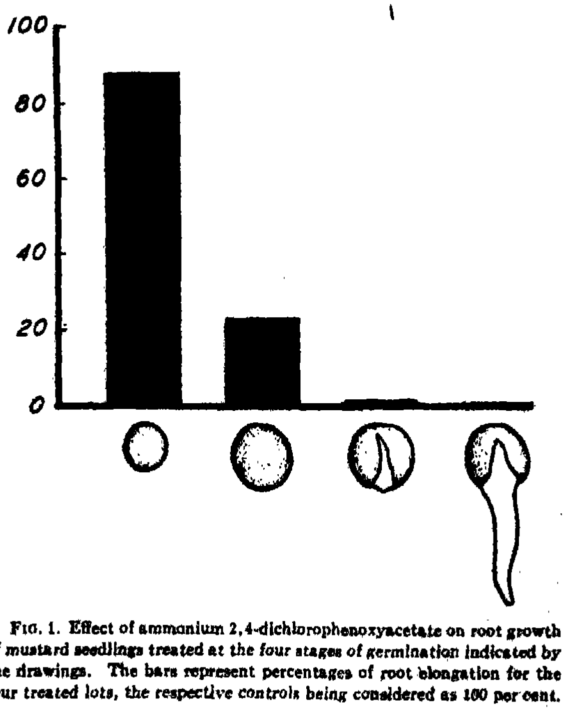

Fig. 1. Effect of ammonium 2,4-dichlorophenoxyacetate on root growth of mustard seedlings treated at the four stages of germination indicated by the drawings. The bars represent percentages of root elongation for the four treated lots, the respective controls being considered as 100 per cent.

The clover seeds were first placed on moist blotters at controlled temperature of 30°C., a condition under which they would absorb water but remain dormant with the seed coats intact. At intervals, samples of the seeds were weighed to

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[1] The authors wish to acknowledge the assistance given by E. H. Toole and Vivian Toole which made this study possible.

determine when the maximum amount of water had been absorbed. They were then divided into 20 groups of 25 selected seeds each. Five groups were planted individually in 0.45 pound of moist, composted soil contained in individual waxed-paper boxes. Five other groups were planted in individual boxes containing an equal amount of composted soil with which 2,4-D had been mixed at the rate of 4 pounds/acre. All 10 boxes were placed at a controlled temperature of 20°C. The same two procedures were then repeated using the remaining groups of seed, but these were maintained in the moist soil at a constant temperature of 30°C.

Seeds in the untreated soil at 20°C. germinated and grew vigorously within a few days after they were planted. Emergence and growth of those in the treated soil were greatly inhibited by the acid (Table 2). After 11 days at 20°C., some plants in the treated soil had grown above the surface, but they were deformed and stunted.

The seeds at 30 C. remained dormant. Inactivation of 2,4-D in the treated soil was determined by repeatedly planting mustard seeds in it. After 19 days, the 2,4-D was completely inactivated, as indicated by the fact that mustard seeds germinated, and the plants grew as vigorously in the treated as in the untreated soil. Boxes containing the treated and those containing the untreated soil were then transferred to 20°C. The clover seeds in both germinated and grew vigorously, none being deformed (Table 2).

It is evident from results with this species of clover that the seeds were relatively resistant to 2,4-D while dormant, but became extremely sensitive to the acid after the seed coats were broken and the seeds began to germinate. Mustard seeds likewise proved to be relatively insensitive to 2,4-D when the compound was applied to the resting seed. Mustard seeds in later stages of germination were extremely sensitive to the compound. It is indicated on the basis of these results that 2,4-D is likely to be most efficient as a preplanting soil treatment for killing seeds of obnoxious plants if applied at a time when the greatest number of such seeds are germinating.

TABLE 2

PERCENTAGES OF EMERGENCE OF SUBTERRANEAN CLOVER (*Trifolium subterraneum*) IN UNTREATED SOIL (U) AND IN SOIL TO WHICH 2,4-D WAS ADDED IN AMOUNTS EQUIVALENT TO 4 POUNDS/ACRE (T)

Replications	7 days at 20°C.		11 days at 20°C.		19 days at 30°C.; 3 days at 20°C.		19 days at 30°C.; 9 days at 20°C.	
	U	T	U	T	U	T	U	T
1	76	0	100	48	88	68	88	80
2	72	0	100	32	44	76	80	88
3	80	0	92	48	48	68	88	80
4	64	0	92	48	44	24	96	96
5	64	0	100	32	92	84	96	80
Average	71	0	97	42	63	64	90	85

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Inactivation of Certain Neurotropic Viruses *in Vitro* by Serum Lipids

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The inactivation of viruses by some lipids, particularly fatty acids and their soaps, is well known (*1*) and has been attributed generally to the surface action of the chemicals. While investigating various aspects of the neutralization test with neurotropic viruses, a slight but definite and reproducible reduction of the titer of the viruses was noted when the latter were incubated with clear sera deriving from several normal animal species, as compared with that shown by viruses in buffered saline solution controls. Moreover, the lipid fraction obtained from such sera either by acetone-ether or by hot alcohol extractions, emulsified in buffered saline solution and added to a virus suspension, induced rapid and pronounced reduction in titer—a drop of .01 to .0001 within 5 minutes.

The test was carried out by mixing equal volumes of a 1:500 suspension of infected mouse-brain in buffered saline solution and of the emulsion of lipid; as a control, a similar mixture was used in which buffered saline solution substituted for the emulsion of lipid. The pH was maintained at 7.0–7.2. The mixtures were then placed in a water bath at 37°C., portions being removed at intervals from 5 minutes to 24 hours and titrated in mice by means of intracerebral injection. Serum lipids from mice, hamsters, rabbits, and horses, have been found active; for practical reasons horse serum has been used extensively. The viruses thus far tested with similar results were those of St. Louis, Russian Far East, and Japanese B encephalitis. Test 1 (Table 1) shows a typical experiment.

TABLE 1

INTRACEREBRAL TITER OF JAPANESE B ENCEPHALITIS VIRUS FOLLOWING INCUBATION AT 37°C. IN THE PRESENCE OF LIPIDS

Test	Virus suspended in:	Length of incubation			
		5 min.	4 hr.	8 hr.	24 hr.
1	Buffered saline (control)	$10^{-8.8}$	$10^{-6.3}$	$10^{-5.5}$	$10^{-3.6}$
	Horse serum lipids	$10^{-6.8}$	$10^{-3.3}$	$<10^{-2.5}$	$<10^{-2.5}$
2	Buffered saline (control)	$10^{-8.7}$		$10^{-8.5}$	$10^{-7.8}$
	Egg-yolk lipids	$10^{-8.1}$		$10^{-8.2}$	$10^{-6.9}$
	Human brain lipids	$10^{-7.6}$		$10^{-6.0}$	$10^{-6.0}$

The viral inactivation took place in the presence of serum protein at 2–4°C., although more slowly, and the inactivating agent was not dialyzable and withstood heating at 99° C. for 1 hour. There was no correlation between the change in surface or interfacial tension brought about by the lipid and the degree of viral inactivation.

Fractionation of serum lipids by using several solvents showed that when serum was extracted in succession with acetone, ether, and hot ethyl alcohol-ether, each extract was effective in inactivating virus. Lipids from other animal sources have been tested. Whole lipids obtained from egg yolk were not effective even after 24-hour incubation; those deriving from brain showed only a moderate activity (Test 2). On fractionation of the brain lipids, the acetone fraction had a marked inactivating action as well as a low surface tension; the ether and hot alcohol-ether fractions were only moderately active, irrespective of surface tension.

The inactivation of neurotropic viruses by serum lipids is now being investigated in connection with (a) the mechanism, including influence of the degree of dispersion, and closer identification of the active agent; (b) the bearing of the results on the neutralization test as it is now carried out; and (c) its possibilities as the basis for chemotherapy of experimental infections.

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The Abundance of Thallium in the Earth's Crust

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The most generally accepted value for the abundance of thallium in the earth's crust is that given by Goldschmidt (*2*) as 0.00003 per cent Tl, by weight.

Although analytical data on the abundance of thallium in rocks are very meager (most analyses for thallium are confined to pegmatitic minerals), it should be possible to make a reasonably accurate estimate of its abundance in the earth's crust as a result of its close association with rubidium in minerals. It has been shown (*1*) that, with the exception of some sulfide minerals where thallium alone may be present, rubidium and thallium are confined essentially to potassium minerals and the cesium mineral, pollucite, and that in these the ratio Rb/Tl varies relatively slightly from area to area and is independent of the type of potassium host mineral (mean weight ratio per cent Rb/per cent Tl = 100). A plot of log per cent Rb_2O vs. log per cent Tl_2O for about 170 mineral specimens so far investigated, covering a thousand-fold concentration range, shows that throughout this range a straight line of unit slope accommodates the plotted points most satisfactorily. Consequently, one may infer that in the earth's crust as a whole the ratio Rb/Tl may be regarded as equal to about 100.

The value of the abundance of rubidium (0.03 per cent Rb) given by Goldschmidt (*2*) is probably reasonably accurate, although this value might be altered slightly because of several relatively recent rubidium determinations on rocks; hence the abundance of thallium in the earth's crust is 0.03/100 = 0.0003 per cent. One may infer, therefore, that the older value (0.00003 per cent) is low by a factor which may be as high as about 10.

It may be noted that, as mentioned above, thallium has a dual geochemical behavior and is usually present as a trace in many sulfides. In comparison with the quantity of thallium in the vast amounts of potash minerals, however, the thallium contained in relatively small quantities of sulfide minerals is probably insignificant; if significant, its presence in sulfide minerals would tend to increase the factor of 10 referred to above.

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Reaction of Certain Plant Growth Regulators With Ion Exchangers

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Several investigators have reported that 2,4-D and certain other plant growth regulators may be readily leached from some soils (*2, 3, 5*). The fact that large volumes of water did not always completely remove the 2,4-D would indicate that some of the compound may be adsorbed by the soil. It was recently shown that 2,4-D is inactivated by adsorption on charcoal (*4*).

The degree of adsorption of several plant growth regulators by certain ion exchange materials and the readiness with which the compounds are eluted after having been adsorbed are reported here.

The cation exchangers used were a resin exchanger, Amberlite IR-100,[1] a carbonaceous exchanger, Zeo-Karb H, a synthetic sodium alumino-silicate, Decalso, and a processed glauconite, Zeo-Dur. The anion exchangers were the amine resins, Amberlite IR-4B and De-Acidite.

All cation exchangers were screened $-20 + 40$ mesh. IR-100 and Zeo-Karb H were treated with a number of portions of 5 per cent hydrochloric acid, with frequent stirring, for a period of 48 hours; Decalso and Zeo Dur, with several changes of 4 per cent sodium or calcium chloride over a period of 24 hours. After the materials were thoroughly washed with distilled water they were dried in an oven at 40°C. The anion exchange materials were prepared by stirring the samples with portions of 5 per cent sodium carbonate over a 24-hour period, washing, and then drying for about 5 hours at 40°C.

Six plant growth regulators were used for experimentation: 2,4-dichlorophenoxyacetic acid (2,4-D), ammonium 2,4-dichlorophenoxyacetate ($NH_4$2,4-D), cupric 2,4-dichlorophenoxyacetate [Cu(2,4-D)$_2$], calcium 2,4-dichlorophenoxyacetate [Ca(2,4-D)$_2$], 2,4,5-trichlorophenoxyacetate (2,4,5-T), and isopropyl N-phenylcarbamate (IPPC). The 2,4-D was purified by running it through several salt-acid cycles. Cu(2,4-D)$_2$ was prepared by reacting an excess of an aqueous solution of $NH_4$2,4-D with a solution of cupric chloride, and then washing the precipitate of Cu(2,4-D)$_2$ free of ammonium chloride. Ca(2,4-D)$_2$ was made by adding calcium chloride to an aqueous solution of $NH_4$2,4-D. The spectrophotometric method developed by Bandurski (*1*) was employed to measure the compounds in solution.

Static trials were divided into two types: (1) those in which it was determined how much of a compound an exchanger material removed from a solution, and (2) those in which elution of regulators from exchangers was studied.

In static trials 0.5-gram samples of the exchanger were placed in 250-ml. Erlenmeyer flasks. Fifty ml. of the appropriate solutions were then pipetted into the flasks, which were then stoppered and allowed to stand for 48 hours, with frequent shaking. At this time the concentrations of the growth regulator in the supernatant liquid were determined, and the amounts of compound adsorbed or eluted calculated.

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[1] The Amberlites were obtained from the Resinous Products and Chemical Company and other exchangers from the Permutit Company.

In elution studies the regulators were dissolved in 95 per cent ethyl alcohol and shaken with the exchangers for about 30 minutes. The alcohol was then evaporated by placing the container in a circulating oven at about 70°C. The growth regulators were also added to exchanger materials by shaking the exchangers with aqueous solutions of the compounds. The amount of regulator adsorbed by the exchanger was calculated by measuring the decrease in concentration of the compound in the supernatant liquid.

Pyrex glass tubes about 40 mm. in diameter and 25 cm. in height were used for studies of leaching. The tubes were tapered at the lower end so that the lower 5 cm. was about ½ inch in diameter. The exchanger beds, which were about 10 cm. in height, were supported by a plug of glass wool at the point of constriction of the tube. A reservoir of liquid could be maintained above the exchanger material. A piece of rubber tubing about 1½ inches long and with a screw-type clamp was fitted over the lower end of the leaching tube.

After the exchanger material was placed in the tube, distilled water was slowly forced into the lower end until the level of water reached the top of the exchanger bed, after which the screw clamp was closed. This backwashing was necessary in order to prevent presence of air pockets in the bed. After the bed was allowed to stand for 15 minutes, 55 ml. of distilled water was added above it. The screw clamp was then opened so that a slow drip rate was obtained which allowed 55 ml. of water to leach through in about 45 minutes.

The relative adsorptive capacities of 6 exchanger materials for 6 plant growth regulators were studied. Aqueous solutions of 0.000226 normality of 2,4-D (50 ppm), $NH_4$2,4-D, Cu(2,4-D)$_2$, Ca(2,4-D)$_2$, 2,4,5-T, and IPPC were prepared. IPPC was considered to have a valence of 1. Fifty ml. of these solutions was added to 0.439-gram samples of IR-4B or 0.5-gram samples of all other exchangers. The data in Table 1 indicate that IR-100 H and Zeo-Karb H adsorbed much of the growth regulators, while the Decalso and Zeo-Dur adsorbed little or none. IR-100 H adsorbed almost equal micro equivalents of 2,4-D and its salts. De-Acidite and IR-4B, however, adsorbed less Cu(2,4-D)$_2$ than 2,4-D, Ca(2,4-D)$_2$, or $NH_4$2,4-D. These results indicate that when 2,4-D or its salts are added to soils in chemically equivalent quantities, equal amounts of the anion might be adsorbed by the soil. This might not hold true in soils containing anion or acid exchanging materials. IR-100 H adsorbed less 2,4,5-T than 2,4-D or its salts, but adsorbed much more IPPC. With the anion exchanger the situation was reversed.

It was determined that IPPC was strongly adsorbed by IR-100 in the hydrogen, sodium, or calcium cycle, while 2,4-D was strongly adsorbed only by the resin in the hydrogen cycle. Much less 2,4-D was adsorbed by Amberlite IR-100 H when the pH of the solution was 3.3 than when it was 2.5 or lower. Perhaps acidic soils would have higher adsorptive capacities for 2,4-D than alkaline soils. The amount of 2,4-D adsorbed by ion exchangers from solutions varying in concentration from 20 to 200 ppm was about directly proportional to the concentration of the 2,4-D in the initial solution.

TABLE 1

ADSORPTION OF PLANT GROWTH REGULATORS BY EXCHANGER MATERIALS*

Compound	Exchanger																	
	IR-100 H			Zeo-Karb H			Decalso			Zeo-Dur			De-Acidite			IR-4B		
	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed	Micro eq. adsorbed	Mg. adsorbed, ½ gram oven-dry exchanger	% adsorbed
2,4-D	5.78	1.46	51.1	11.0	2.58	97.3	00	00	00	00	00	00	5.23	1.83	46.2	9.05	2.53	80.0
$NH_4$2,4-D	5.97	1.62	52.8	11.0	2.78	97.3	00	00	00	.16	.041	1.41	5.08	1.91	44.9	8.45	2.55	74.7
Cu(2,4-D)$_2$	5.72	1.64	50.6	11.0	2.93	97.3	00	00	00	.01	.003	0.09	3.42	1.36	30.2	7.70	2.46	68.1
Ca(2,4-D)$_2$	6.13	1.68	54.2	11.1	2.82	98.1	.27	.70	2.39	.18	.047	1.59	5.49	2.08	48.5	8.60	2.62	76.0
2,4,5-T	4.77	1.39	42.2	11.0	2.98	97.3	00	00	00	.73	.201	6.45	6.17	2.49	54.6	9.21	2.99	81.4
IPPC	8.70	1.78	76.9	11.2	2.13	99.0	.45	.87	3.98	.43	.083	3.80	1.03	0.29	9.1	5.47	1.24	48.4

* Each figure is average of 3 replicates.

Less elution of 2,4-D from Amberlite IR-100 H was caused by 0.75 N solutions of NaCl, $CaCl_2$, or $AlCl_3 \cdot 6H_2O$ than by water (Table 2). Similar results were obtained with solutions containing anions of three different valences. IPPC, however, was eluted from IR-100 H by NaCl solution. Hydrochloric acid readily eluted 2,4-D from the acid exchangers IR-4B and De-Acidite. These data suggest that much of the 2,4-D in soil remains adsorbed and not subject to leaching.

TABLE 2

ELUTION OF 2,4-D FROM 0.5-GRAM SAMPLES OF IR-100 H BY WATER AND 0.75 N SOLUTIONS CONTAINING A MONO-, DI-, OR TRIVALENT CATION

Solution	2,4-D eluted	2,4-D eluted
	(mg.)	(%)
water	0.685	45.7
HCl	0.720	48.0
NaCl	0.335	22.3
$CaCl_2$	0.370	24.7
$AlCl_3$ 6H_2O	0.436	29.1

Comparative rates of leaching of 2,4-D, $NH_4$2,4-D, Cu(2,4-D)$_2$, 2,4,5-T, and IPPC from beds of Decalso and Zeo-Dur about 10 cm. in height were studied. One-half or more of all the compounds were usually leached from the exchanger materials by 55 ml. of water, and the compounds were usually removed in about the same amounts. The relatively soluble $NH_4$2,4-D was not removed in greater quantities than 2,4-D, which is of much lower solubility. It seems probable that in a soil 2,4-D or a relatively insoluble 2,4-D salt might be converted to soluble forms by ammonium, sodium, or other ions present in the soil solution.

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Granulosa Cell Tumors in Intrapancreatic Ovarian Grafts in Castrated Mice[1]

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Biskind and Biskind (*1*) reported that granulosa cell tumors have developed in ovaries transplanted into spleens of three castrated female rats. Our previous experiments showed the formation of granulosa cell tumors and luteomas in intrasplenic ovarian grafts in castrated male and female mice (*3*). These studies were based on two principles: (1) the capability of the liver to inactivate ovarian hormones when the hormones circulate through the hepatic portal system, and (2) the increase of pituitary gonadotropins subsequent to castration. It was assumed that the prolonged stimulation, by augmented amounts of gonadotropic hormones, of intrasplenic ovarian grafts was responsible for the neoplastic growths. More recent investigations (*2*) revealed that the development of ovarian tumors in intrasplenic ovarian grafts was inhibited by administration of estradiol benzoate and testosterone propionate. The malignancy of the induced granulosa cell tumors was indicated by the ability to metastasize and to transplant in new hosts. The present experiment, using intrapancreatic ovarian transplantation in castrated mice, demonstrates that splenic tissues do not play a direct role in the pathogenesis of ovarian tumors arising in the grafts.

Male and female mice of A, C_3H, CBA, and C_{57} strains and hybrid mice were used. These were castrated and received, at the same time, an autoplastic or homoplastic ovarian graft in the pancreas. Among the first group of 5 experimental animals, two granulosa cell tumors and one pretumorous growth were found 168 days after grafting. No tumor was noted in two grafts with vascularized adhesions that permitted drainage through other than the hepatic portal system. One tumorous graft in a male mouse (C_3H strain) was 7 x 8 x 10 mm. in diameter; the other, which developed in a female hybrid mouse (AC_3), measured 10 x 11 x 13 mm. in diameter. The uterus of the latter animal weighed 75 mg. at autopsy. The pretumorous graft occurred in a male mouse of the A strain.

Microscopically, the granulosa tumor cells were arranged in a folliculoid pattern showing numerous mitotic figures. Some of the folliculoid structures contained hemorrhagic cavities. Luteinized cells and small necrotic areas were present, and a spicule of bone was observed at the periphery of one tumorous ovarian graft. Major portions of the tumors were separated from the pancreatic tissue by bursa-like spaces lined by germinal epithelium. No metastasis was observed in the liver. The pretumorous graft showed masses of tubular ingrowths from the germinal epithelium, and the transformation of some of the epithelial cells into granulosa tumor cells was noted. Thus, the morphology of granulosa cell tumors induced in the pancreatic site resembled that of the tumors developed in intrasplenic ovarian grafts. The present experiments are interpreted to substantiate further the assumption that overaction of gonadotropic hormones is responsible for the development of the ovarian tumors in mice.

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[1] This research has been aided by grants from the Anna Fuller Fund and the Jane Coffin Childs Memorial Fund for Medical Research.

Differential Phytotoxicity of Metabolic By-Products of *Helminthosporium victoriae*[1]

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The "*Helminthosporium* blight" of oats caused by *H. victoriae* Meehan and Murphy has developed so rapidly that it has attained the proportions of a major plant disease within two years after its discovery. Susceptibility is apparently limited to oat varieties and selections that possess the "Victoria-type" resistance to crown rust (*Puccinia coronata avenae* (Corda) Eriks. & E. Henn.). The unusually fast build-up of the disease has been facilitated by the widespread planting of large acreages to susceptible varieties.

The means by which *H. victoriae* causes necrosis has been the subject of some speculation. In a previous article (*2*) the suggestion was made that the pathogenic action of this fungus involves the production of a toxic substance. Inoculation tests with sterilized mycelium and filtered extracts from cultures have given evidence that a very potent toxin is secreted by the fungus, which is responsible for the characteristic longitudinal foliar striping or discoloration. Data regarding its production and effects are briefly summarized in this paper.

Evidently the basal infection of the oat plant is the only direct manifestation of parasitic action by *H. victoriae*, since the organism has not been isolated from the blighted leaves until after complete necrosis of the tissue. It may be that this

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[1] Journal Paper No. J-1027 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project No. 72. Cooperative investigations between the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Botany and Plant Pathology Section, Iowa Agricultural Experiment Station.

fungus is too weak a parasite to establish infection in healthy tissue even of susceptible oat varieties without the help of toxic secretion in advance. Otherwise, it would be expected that a fungus that grows vigorously in culture would progress rapidly in the plant from the basal portions to the leaves.

Preliminary tests showed that the toxic substance or substances were readily formed in cultures grown on media containing either organic or inorganic nitrogen. In a typical experiment, cultures of *H. victoriae* were grown for 30 days at room temperature (24–28° C.) in flasks, each containing 100 ml. of Richard's solution, filtered through a Büchner funnel to remove the hyphal mass, and the filtrate then passed twice through a Berkefeld filter to render it aseptic. Boone and Clinton oat seedlings were grown for one week in nutrient water culture, after which time the nutrient solution was replaced by the filtrate in a series of dilutions ranging from 1:15 to 1:1,800 in tap water. Observations made at 4-hour intervals showed the following reactions in the susceptible Boone variety: at dilutions of 1:90 or less the leaf blades became rigid and inflexible within 40 hours, and after 48 hours these leaves showed a slight twisting. A more critical indication of phytotoxicity was obtained at dilutions of 1:45 or less: the healthy green color of normal leaves changed to a dull grayish-brown after 52 hours. This color change preceded the death and drying of the leaves. The seedlings of the resistant variety, Clinton, were unaffected by the filtrate in these dilutions. Since it was found that Richard's solution alone, minus the amount of sugar equivalent to that used by the fungus in growth, was harmless to the susceptible plants, it may be concluded that a substance was formed as a metabolic by-product of the growth of *H. victoriae* that was toxic to the susceptible variety of oats. The color reaction is considered most reliable for bioassay technique, since it was obtained consistently at the same dilution range in a series of tests.

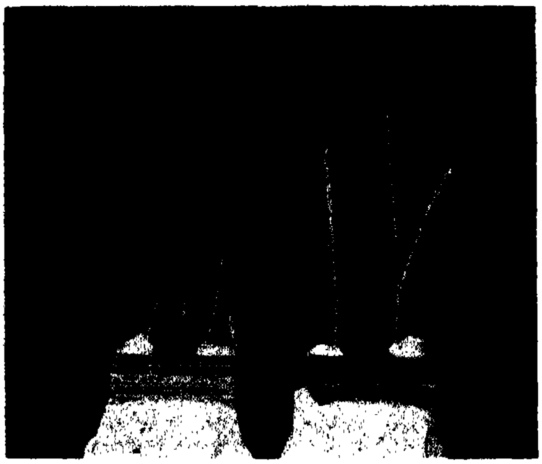

FIG. 1. Oat plants of varieties Boone (left) and Clinton (right) grown in nutrient solution, 90 hours after toxic extract, 1 part in 45 parts of water, had been added.

The toxin occurs in the cells of *H. victoriae* as well as in the nutrient medium, as shown by the fact that leaves of susceptible oat varieties were killed when sprayed with a water suspension of sterilized blended mycelium containing no culture substrate.

The toxic principle in the culture extract is relatively stable, as it was not destroyed by autoclaving for 20 minutes at 15 pounds pressure. Lee's work (*1*) with *H. sacchari* (Breda de Haan) Butler showed this fungus to have a strong capacity for reducing inorganic nitrates to nitrites which were assumed to be responsible for the toxicity of this organism to sugar-cane leaves. The production of toxin by *H. victoriae* on media containing only organic sources of nitrogen is evidence that nitrite formation is not the cause of this toxic action.

Some tapering-spored species of *Helminthosporium* have been found to produce characteristic intracellular chemical compounds (*3*) of the polyhydroxyxanthone series, such as *ravenelin* (3 methyl-1,4,8-trihydroxyxanthone) in *H. ravenelii* Curt. Further studies will be required to determine whether comparable materials are present in the toxic solutions from *H. victoriae*.

H. victoriae is primarily a facultative soil- and seed-borne saprophyte that possesses a low order of phytopathogenicity. It causes severe leaf blight in addition to basal stem and root necrosis without invading the plants extensively. The limited progress it does make may depend largely upon direct injury to plant tissues by the toxin. Varieties of oats such as Clinton, that are highly resistant to, or immune from, attack by the fungus itself, are likewise not injured by the toxic secretions. The extreme susceptibility to the fungus exhibited by the Victoria derivatives might be reasonably expected, since the resistance shown by these varieties to crown rust is dependent upon a hypersensitive reaction to the rust fungus, an obligate parasite.

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Application of "Metabolite Antagonism" to Cancer Research

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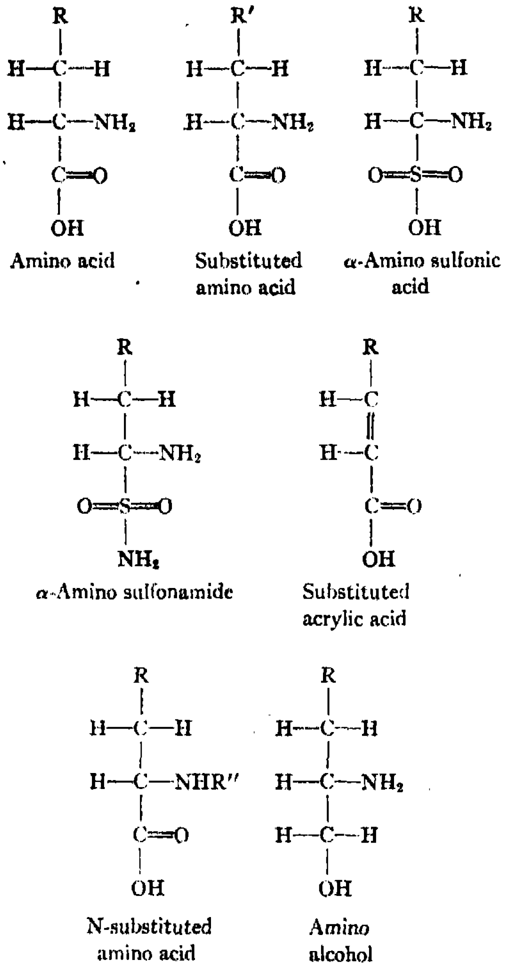
The concept that a compound structurally related to an essential metabolite may interfere with the function of that metabolite has been attracting widespread attention (*5*). The initial stimulus in establishing the "metabolite antagonist" concept has come from the work of Wood and Fildes (*6*), who demonstrated the antagonistic effect of p-aminobenzoic acid on the action of sulfanilamide. Subsequent investigations from other laboratories (see Roblin, *5*) have attempted to find synthetic substances which, as in the case of sulfanilamide, would be incapable of duplicating the physiological action of the metabolite, but would possess great affinity for the same enzyme system and/or other cell constituent with which the metabolite reacts. These attempts have been successful in some instances. In view of the more rapid growth of tumor tissue as compared with normal tissue, it seems plausible to us that it may be possible to interfere with the growth of the malignant tissue to a greater degree than with normal tissue by making use of an appropriate metabolite antagonist. Thus, regression of a tumor might be affected. Burk and Winzler, in a recent review article (*2*), have proposed a somewhat similar approach to cancer studies, utilizing competitive vitamers to produce differential vitamin deficiencies in growing and nongrowing tissues.

Since amino acids serve as building blocks in the formation of proteins of normal as well as neoplastic tissue, and further, since proteins are intimately concerned with the functions of protoplasm, our attention was first focused on potential amino acid antagonists (see Fig. 1). It is the purpose of this report to furnish a brief account of preliminary experiments concerning the effects of several amino acid analogues on tumor growth. Future work will deal with other types of potential metabolite antagonists and their application to metabolic studies in normal and cancerous tissues.



Amino acid

Substituted amino acid

α-Amino sulfonic acid

α-Amino sulfonamide

Substituted acrylic acid

N-substituted amino acid

Amino alcohol

R = alkyl or aryl group; R′ = variation of alkyl or aryl group; R″ = group replacing H atom of —NH_2.

FIG. 1 Potential metabolite antagonists of amino acids.

Because of the relative ease of preparation of α-aminosulfonic acids as contrasted with other potential antagonists, these were used exclusively in this study. Aminomethane sulfonic acid, the compound resembling glycine, was prepared according to the directions of Raschig and Prahl (*4*); α-aminoethane sulfonic acid, the sulfonic acid analogue of alanine, according to Backer and Mulder (*1*); α-aminoisobutane and α-aminoisopentane sulfonic acids, analogues of valine and leucine, respectively, according to McIlwain (*3*); and α-amino, β-phenylethane sulfonic acid, the analogue of phenylalanine, was synthesized in this laboratory. For simplicity, the sulfonic acid corresponding to the amino acid will be referred to as the S-amino acid. Thus, α-amino,β-phenylethane sulfonic acid is S-phenylalanine, while α-aminoisobutane sulfonic acid will be called S-valine.

Highly inbred "A" mice of both sexes were used. The diet of the animals consisted of Purina Laboratory Chow plus twice-weekly supplements of lettuce. The tumor tissue, Sarcoma A274,[1] was inoculated subcutaneously into the right groin by means of a trochar. Eight days after implantation, the animals were matched according to tumor size. Then, 36 animals with equal-sized tumors (about 1 cm.) were divided into 6 experimental groups of 6 animals each. One of these groups was a control series for all groups, and these 6 mice received no therapy. Each of the remaining 5 groups consisted of 4 test and 2 control animals, the former receiving daily intravenous injections of the S-amino acid while the latter were injected with the equivalent weight of the corresponding dl-amino acid. The groups were: (I) S-glycine, (II) S-alanine, (III) S-phenylalanine, (IV) S-leucine, and (V) S-valine. In all cases the compounds were administered in a total volume of 0.2 ml., the pH of each solution previously being adjusted to 7.4 with 0.2 N sodium hydroxide. Preliminary trials for toxicity level were carried out on other animals, and in all cases daily intravenous doses several times those employed here were well tolerated and no toxic symptoms were observed. After one week, intravenous administration was abandoned, and subcutaneous injections (0.2 ml.), twice daily, were employed. The injections were made at a site far removed from the region of the tumor implantation, namely, into the midscapular region.

The final growth of the sarcoma was not affected appreciably by the administration of the S-amino acid or even by the corresponding dl-amino acid. The experiment, which was terminated 19 days after tumor implantation because several test and control animals succumbed, is being repeated with variations of the experimental conditions and with additional analogues.

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[1] This sarcoma originated at the Wistar Institute. It is a vigorous tissue, palpable three days after implantation and causing death in about three weeks. Sarcoma A274 has been maintained in "A" mice for many generations, 146 transplants having been made since the tumor first appeared. Spontaneous regressions have not been observed to date.

IN THE LABORATORY

A Slide Rule for Determining Chicken Red Cell Agglutination Titer

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Because of the extensive use of the turbidimetric chicken red cell agglutination (CCA) test at this laboratory in checking production and research on influenza virus, it became desirable to provide a rapid method for evaluating the results. This is customarily done by means of a nomograph[1] with a scale of colorimeter readings along each vertical edge (the nomograph and the slide rule are based on readings obtained from the Klett-Summerson colorimeter). After determining the two virus dilutions which give colorimeter readings bracketing the 50 per cent end-point control, a straight edge is applied to these two readings on the nomograph, and an interpolating factor is read from the horizontal scale above the intersection of the straight edge and the line representing the colorimeter reading of the control. This interpolating factor is then referred to a table, and the desired CCA titer is read therefrom.

A slide rule has been devised in order to carry out these operations more rapidly. The equation involved (*1*) is

$$\log D = \log S + \frac{Y - X}{Z - X} \log 2,$$

where D is the dilution giving 50 per cent agglutination; S, standard dilution of the unknown which is the lower of the two dilutions bracketing the control value; Y, colorimeter reading of control; X, colorimeter reading of S; and Z, colorimeter reading of standard dilution of unknown which is the higher of the two dilutions bracketing the control value.

The slide rule, which provides a means for determining the fraction $\frac{Y - X}{Z - X}$ and calibrates this value directly against the CCA titer, is constructed as shown in Fig. 1. A and B are matching linear scales; C and D are matching logarithmic scales; and the lower four lines are actual CCA values.

Use of the rule requires the following steps:

(1) The lower colorimeter reading (X, above) is taken on the A scale and placed opposite the higher colorimeter reading (Z) on the B scale. This gives a reading on the B scale opposite the A scale index.

(2) The hair line is then set on the D scale at the value obtained from step 1.

(3) The lower colorimeter reading (X) is taken on the A scale and placed opposite the control colorimeter reading (Y) on the B scale. This again gives a reading on the B scale opposite the A scale index.

(4) The sliding portion of the rule is then moved so that the value obtained in step 3, taken on the C scale, is under the hair line.

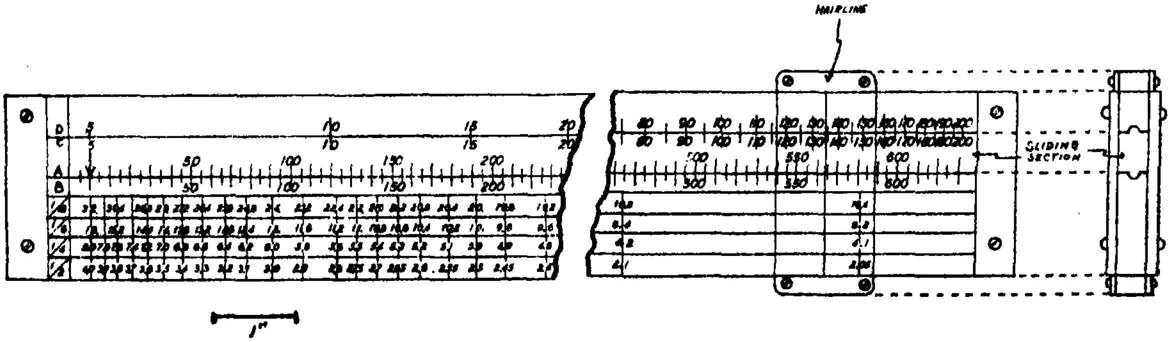

FIG. 1

(5) The index on the left end of the sliding portion then is directly opposite the required CCA value on the four bottom scales, which give a range from 1:2 to 1:32, as shown. If desired, this can be extended by adding more lines. The CCA value is read from the appropriate scale; *i.e.* if the needed figure falls between the 1:2 and 1:4 dilutions, the reading is made on the 1:2 line, etc.

Steps 1 and 2 are subtractions which are usually very simple, so that by performing them mentally further time can be saved.

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[1] NIH directions for the titration of the chicken red cell agglutination (CCA) activity of influenza virus and vaccines according to Hirst's method as modified for use in the Laboratories of the Rockefeller Institute at Princeton, New Jersey.

Olive Oil as a Solvent for Certain Organic Vapors

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According to Henry's law the solubility of a gas (or vapor) in a liquid is proportional to its partial pressure above the solution, in accordance with the equation p = KC, where p is partial pressure of the vapor; C, its concentration in solution at equilibrium; and K, a constant. In certain toxicity studies at Edgewood Arsenal, olive oil was used as representative of the body fats, and in connection with proposed calculations of a theoretical nature it was desired to determine to what extent the solubility of the vapors of certain organic compounds in olive oil proceeds in accordance with Henry's law.

The organic compound (about 40 cc.) was contained in a bead bubbler with a diameter of about 40 mm. and capacity of about 80 cc. of liquid, which gave within 2 per cent of saturation at a moderately slow rate of air flow of about 50 cc./minute. Dry air was passed through the bubbler at a measured rate of flow and mixed with a second metered stream of dry air. The diluted vapor was then bubbled through olive oil of known weight, contained in parallel absorption tubes (for check results). The apparatus was all glass except for a few rubber connections, and except for the flowmeters was immersed in a water bath maintained at constant temperature. The concentration of vapor in the air stream was calculated from the flow rates. The saturation concentration in air, shown in Table 1, was based on the assumption that the vapor follows the ideal gas law.

Pompeiian brand olive oil was used from newly opened cans. This oil was brought to constant weight by passing dry air through it for 4 days at 20° C., at the end of which time it was found not to lose weight appreciably. In the solubility determinations (Table 1) at definite partial pressure of vapor it was found that equilibrium was reached in 11–14 hours, as determined by constancy of weight of the absorption tubes.

TABLE 1

Absorption of Vapors* by Olive Oil at 20° C.

Nitromethane		Chloroform	
Vapor pressure . . . . . . 28.4 mm.		Vapor pressure . . . . . . 160 mm.	
Saturation concentration . . . . . . 94.9 mg./l.		Saturation concentration . . . . . 1,046 mg./l.	
Saturation in air (%)	Mole fraction in oil†	Saturation in air (%)	Mole fraction in oil†
10.9	0.11	13.2	0.50
17.1	0.16	23.8	0.63
23.8	0.21	43.0	0.75
33.7	0.28		
42.8	0.32		

* In one experiment with menthol (v.p. = 0.021 mm. and saturation concentration = 0.18 mg./l.) it required 66 hours to reach equilibrium; the mole fraction in oil was 0.19 at 31.8 per cent of saturation in air.

† Molecular weight of olive oil taken as 885. Saponification value = 193.

The solubility data for the two compounds in olive oil are plotted in Fig. 1 in such a way as to compare the experimental data with the ideal solution behavior (the broken line in Fig. 1) expressed by Raoult's law, $p = p_0x$. Since the data represent systems of two miscible liquids, no distinction need be drawn between solvent and solute. When plotted as indicated, chloroform, for example, would conventionally be considered as the solvent and olive oil as solute, with p_0 as the saturation pressure of chloroform; x, its mole fraction in the solution; and p, its pressure at the concentration x. The oil-chloroform system shows a great negative deviation (above-normal solubility of chloroform).

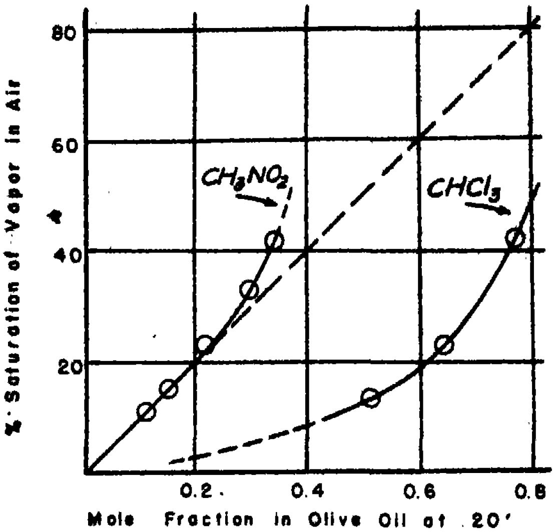

Fig. 1. Deviations from Raoult's law (olive oil as solute); deviations from Henry's law (olive oil as solvent).

TABLE 2

Concentration of nitromethane (grams/100 grams solution)	Temperature (°C.)
Solubility of nitromethane in olive oil	
9.31	3.0
10.79	17.1
11.94	24.5
14.65	41.2
Solubility of nitromethane in water	
9.32	0.7
10.39	15.8
11.29	25.7
13.17	40.5

The oil-nitromethane system, considering nitromethane as solvent, follows Raoult's law fairly well up to a concentration of about 0.2 mole fraction of nitromethane. At higher concentrations than this there is a pronounced positive deviation (below-normal solubility of nitromethane). Although the vapor solubility work was not carried out at higher concentrations than those shown in Fig. 1, it was found that nitromethane and olive oil form a two-liquid system at 20° C. when the mole fraction of nitromethane in the oil phase reaches 0.67 (interpolated from data in Table 2).

To interpret the data on the basis of Henry's law, olive oil is regarded as the solvent, which corresponds with the experimental procedure. Dilute solutions with nitromethane as solute follow this law to the extent that Raoult's law is followed as stated above. As to chloroform as solute, data were not obtained at low enough concentrations to determine if the ratio between concentration in the oil phase and pressure in the vapor phase would be constant in dilute solution.

Solubility of nitromethane in olive oil and in water. The solubility determinations were made by the synthetic method, using total quantities of about 5 grams in sealed glass tubes. Temperatures at which turbidities appeared or disappeared could be determined over a range of about 0.5°. The data obtained are recorded in Table 2.

New Rectal Culture Tube[1]

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The importance of examining material obtained directly from the intestinal wall in the diagnosis of infectious diarrheas has been stressed in recent years by students of the subject. The sigmoidoscopic mucosal crypt aspirator has been described elsewhere (*1*). It is essentially a heavy-walled capillary tube 40 cm. in length, with the distal 2.5 cm. bent 15 degrees for better approximation of the tip to the intestinal mucosa. At the point of bending, the capillary canal is blown into a small elliptical dilatation of sufficient size to hold two or three drops of aspirated material. This instrument requires the use of a sigmoidoscope, and it is applied to the mucosa by direct vision.

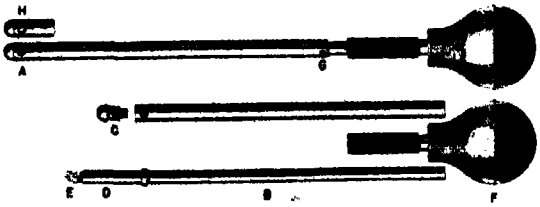

FIG. 1

The new rectal culture tube (Fig. 1) may be used without the aid of the proctoscope or sigmoidoscope. It consists of a metal outer tube 18 cm. in length with a round opening 0.5 cm. in diameter (A) near its distal end. An inner tube (B) screws into a detachable receptacle (C) with smooth tip 1.4 cm. in length and containing a shallow trough. When fitted together, the trough coincides with opening A in the outer tube and may be opened or closed by a quarter turn at D, which represents the proximal end of the inner tube, containing a cotton filter (E), to which a small aspirating rubber bulb (F) is attached.

In actual use, the sterile, assembled, rectal culture tube (without rubber bulb), contained in a stoppered sterile test tube, is removed and lubricated at its distal end (A) by dipping it into sterile glycerine. The rubber bulb is attached to the proximal end. The metal tube, with receptacle at A closed, is then inserted into the rectum for a distance of approximately 10 cm. The inner tube is given a quarter turn, indicated by an arrow at G and a small stop at H. This opens the receptacle at A, which is then applied to the rectal mucosa. The exudate is aspirated into the receptacle, which is promptly closed by a quarter turn in the reverse direction, and the instrument is removed from the bowel. The material may be cultured and wet smear studies made at once by opening the receptacle and blowing out the aspirated material on suitable culture media and slides; or the closed instrument can be dropped into the original test tube and transported to the laboratory. Sterilization and cleaning of the three simple components of the instrument are effected quickly, efficiently, and economically.

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[1] The author wishes to acknowledge the assistance given him by Clay-Adams Company, 44 East 23rd Street, New York City, in the designing of this tube.

Comparison of Hematocrit Methods[1]

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In connection with a study on relative corpuscle and serum (plasma) volumes in blood, selection of a reliable hematocrit method has become a matter of primary concern. While the physical factors which affect the final volume of centrifugally packed corpuscles are well known (*4, 5, 6*), this information is frequently ignored in practice, with the result that many different forms of apparatus have been proposed and are in common use for routine work. In these experiments, three such methods were compared, first, as to their reliability in detecting known dilutions of blood, and second, as to differences among the absolute measurements obtained.

The comparisons were made on each of 10 samples of defibrinated beef blood, and on 3 dilutions of each sample with its own serum. The dilutions contained 90, 80, and 50 per cent of whole blood, respectively.

The types of hematocrit tubes employed and the details of centrifugation were as follows:

Method 1. Straight-walled glass tubes of the Daland (*1*) type, 50 mm. long with 1-mm. bore, were rotated in a standard Daland head at 12,000 r.p.m. and 4.7-cm. effective radius (centrifugal force, approximately 7,500 × G) until constant sediment volumes were obtained. This usually required less than 10 minutes of actual spinning and in every instance caused translucence of the sediment column (*3*).

Method 2. Straight-walled glass tubes of the Wintrobe (*7*) type, 11.5 cm. long with 3-mm. bore, sealed at one end, were rotated in an International centrifuge at 3,000 r.p.m. and 14-cm. effective radius (centrifugal force, approximately 1,400 × G) for one hour.

Method 3. Ordinary, tapered, graduated, 15-ml. centrifuge tubes, containing 10 ml. of blood, were rotated at the same time and under the same conditions as described for Method 2, following closely the recommendations of Haden (*2*).

All tests were in duplicate, the pairs being centrifuged simultaneously. Paired observations differed by 1.0 volume per cent or less in 95 per cent of the tests.

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[1] Presented before the 31st Annual Meeting of the Federation of American Societies for Experimental Biology, Chicago, Illinois, May 18–22, 1947.

Typical results are presented in Table 1. Table 2 summarizes the data, giving the major statistical constants for relative volumes of red cells, errors in prediction of dilution, and deviations from the results of an arbitrary reference standard.

TABLE 1

Sample No.	Whole blood in mixture (%)	Relative volumes of red cells (Vol. %)		
		Method 1	Method 2	Method 3
4	100.0	40.5	41.1	41.3
	90.0	35.5	36.8	37.5
	80.0	32.0	32.4	34.1
	50.0	20.0	19.8	20.4
5	100.0	44.5	47.0	48.3
	90.0	40.5	42.0	43.0
	80.0	36.0	36.6	37.2
	50.0	22.5	22.9	22.6
6	100.0	46.0	46.2	47.8
	90.0	41.0	41.9	42.3
	80.0	36.5	36.8	39.0
	50.0	23.0	23.3	24.3

With regard to the actual hematocrit values obtained, the methods yielded slightly different but statistically indistinguishable means and variance for the entire series and at each dilution level (Table 2, A).

TABLE 2

Method No.	Obs.	Mean	S.E.	Max.	Min.	Alg. mean	Distribution of errors		
							Under 1%	Under 3%	Under 5%
A. Relative volumes of red cells									
	No.	Vol. %	Vol. %	Vol. %	Vol. %				
1	44	35.5	1.3	52.0	18.5				
2	38	35.7	1.6	53.5	18.3				
3	38	36.6	1.6	54.1	19.0				
B. Errors in prediction of dilution									
	No.	%	%	%	%	%	% of obs.	% of obs.	% of obs.
1	33	0.95	0.12	2.78	0.00	−0.29	51.5	100.0	100.0
2	28	2.05	0.29	5.50	0.00	−1.89	42.9	75.0	96.4
3	28	1.95	0.28	6.40	0.00	−1.34	32.1	78.5	96.4
C. Deviations from results by Method 1*									
2	38	2.20	0.26	7.30	0.33	+1.51	13.2	73.7	92.1
3	38	3.53	0.31	8.54	0.00	+3.53	10.5	39.5	81.5

* Method 1 was arbitrarily taken as a standard to illustrate the magnitude of differences among the methods.

With respect to quantitative detection of blood dilution, the various methods yielded the errors summarized in Table 2, B. The mean error for Method 1 was significantly lower than those for the remaining methods. Further, all errors for Method 1 were less than 3.0 per cent of the expected value, an accuracy attained in about three-fourths of the tests for Methods 2 and 3. The algebraic mean for all methods was negative in sign, indicating a preponderance of relatively low readings for the diluted samples. This feature was much less prominent for Method 1 than for the other methods. Methods 2 and 3 were about equivalent in reliability, while Method 1 was definitely superior from the standpoint of revealing degree of blood dilution.

Table 2, C, contains an analysis of individual deviations among the methods, based on Method 1 as an arbitrary reference standard. The difference between the means was significant, and the variance indicated definite disparity between the two methods, although the total range was about the same for both. With regard to distribution of these deviations, Method 2 was superior to Method 3, especially as to errors less than 5.0 per cent. The algebraic mean for both methods was positive in sign, indicating a tendency for both of these procedures to yield high results in comparison with Method 1. Results for Method 3 exceeded those for Method 1 in 95 per cent of the observations. Readings for Method 3 exceeded those for Method 2 in about three-fourths of individual comparisons, while the latter were greater than the values for Method 1 in roughly the same proportion. Degree of dilution did not significantly affect the relative differences between the values for Method 1 and those for the other methods.

The three hematocrit methods studied, involving widely different varieties of tubes and different conditions of rotation, produced results which, on the average, were not seriously divergent. At the same time, differences among the methods appeared in the comparisons of results on individual samples and in the accuracy with which known dilutions of blood were revealed by hematocrit observations. Method 1 was the most satisfactory from both points of view, yielding, in general, the lower hematocrit values and measuring degree of dilution with an average error of less than 1.0 per cent. The further advantages of speed and minimal blood requirement were obvious. Method 2 was generally more satisfactory than Method 3. Although it was no more accurate in revealing dilution, it gave results more nearly approximating the values for Method 1, and the distribution of its errors and deviations was more favorable. The amount of blood required was not excessive, and no special equipment, aside from the tubes, was necessary. Method 3 was considered the least reliable. Its accuracy in detection of dilution, while comparing favorably with Method 2, was distinctly inferior to Method 1. Furthermore, results obtained by Method 3 were consistently higher than those of other methods—a significant point in view of the general criticism of centrifugal methods, namely, that cell volumes so determined are always high because of the presence of fluid in the sediment.

The study indicated that, for problems demanding a high degree of accuracy, commonly employed hematocrit techniques are not equivalent, and that average comparative results are not necessarily trustworthy criteria of the general reliability of such methods.

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The Halogen-Metal Interconversion Reaction and Its Application to the Synthesis of Nicotinic Acid Labeled With Isotopic Carbon[1]

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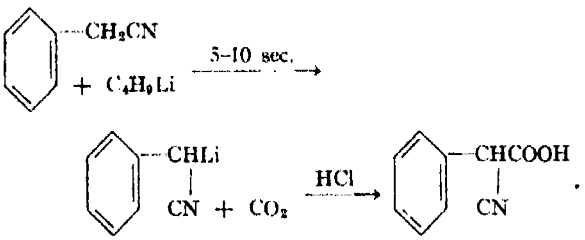
The halogen-metal interconversion reaction is essentially a double decomposition reaction between an organoalkali compound (usually a metal alkyl) and an aryl halide:

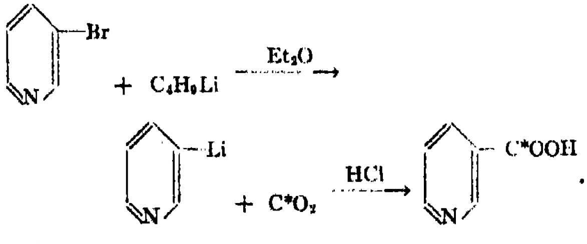
$$\text{R-X} + \text{R}'\text{-M} \leftrightarrows \text{R-M} + \text{R}'\text{-X}.$$

Gilman, Langham, and Moore (*1*) made an extensive study of the application of the above reaction to the preparation of a number of unusual organolithium compounds. The extremely short reaction times required permit the preparation of organometallic compounds having additional functional or reactive groups, a feat not possible in the usual Grignard preparation. Like the Grignard reaction, however, these reactions yield carboxylic acids when carbonated with CO_2.

The extreme rapidity of the exchange reaction is not confined to the halogen-metal interconversion alone but may be evidenced in special cases of the hydrogen-metal exchange. For example, if benzyl cyanide is treated with n-butyl lithium, a 55 per cent yield of phenylcyanoacetic acid results from carbonation within 5–10 seconds. The reaction proceeds according to the following equation:

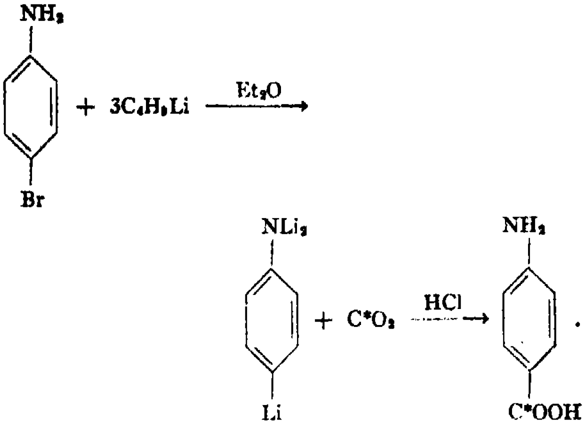


Using n-butyl lithium and 3-bromopyridine according to the method reported by Gilman and Spatz (*2*), 3-pyridyl lithium was prepared. The reaction was scaled down to the millimol level and carbonation effected with $C^{13}O_2$ and $C^{14}O_2$, generated by treating the respective isotopic barium carbonates with concentrated H_2SO_4. Isotope-labeled nicotinic acid (3-pyridine carboxylic acid) resulted according to the following reactions:



A reaction employing *21* millimols of $BaC^{13}O_3$ resulted in an *82* per cent crude yield of nicotinic acid having a C^{13} content of 0.9 isotopic per cent. When the reaction was repeated using 0.8 millimol of $BaC^{14}O_3$, the crude yield of C^{14}-labeled nicotinic acid was *62* per cent. The material had a specific activity of approximately 8 microcuries/mg.

The interconversion reaction between n-butyl lithium and p-bromoaniline (*3*) is being employed for the synthesis of p-aminobenzoic acid labeled with isotopic carbon according to the following reactions:



A reaction using 3 millimols of ordinary $BaCO_3$ has resulted in a 21 per cent yield of p-aminobenzoic acid of high purity.

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[1] This paper is based on work performed under Contract W-7405-Eng-36 with the Manhattan Project at the Los Alamos Scientific Laboratory of the University of California.

Analytical Determination of Basic Groups in Amino Acids and Proteins

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In the course of work upon proteins, it has been found that the basic groups of amino acids (except arginine and histidine) or of proteins can be determined rapidly and simply.

The sample (0.2 gram of amino acid or 2 grams of protein) is dissolved at room temperature in 100 ml. of 0.05 N $Ca(NO_3)_2$ solution saturated with $Ca(OH)_2$. An excess of solid $Ca(OH)_2$ (0.5 gram) is added, and the mixture is shaken repeatedly during two hours. It is then filtered and protected from the air to avoid carbonation. An aliquot is titrated with standard HCl (0.05 N). A blank containing no amino acid or protein is prepared at the same time and carried through simultaneously with the sample. The difference between sample and blank represents the basic groups in the sample and may be expressed as the per cent of basic nitrogen in the sample. Results on pure amino acids are accurate to within 1.5 per cent error.

This method has some advantages over the Sorensen method, particularly with regard to proline and hydroxyproline, which can be titrated accurately by the present method.

A similarly simple method of determining the acid groups of amino acids and proteins has been sought, but completely satisfactory results have not been obtained. Use of picric acid has given the best results to date.

Book Reviews

Fundamental chemistry: an elementary textbook for college classes. (2nd ed.) Horace G. Deming. New York: John Wiley; London: Chapman & Hall, 1947. Pp. xvi + 745. (Illustrated.) $4.00.

Teachers who are interested in a presentation of elementary chemistry which encourages thought and the development of a questioning and scientific attitude on the part of the student, teachers who are desirous of a treatment which is not repetitious to the student who has already had some training in chemistry, and students who are concerned with improving their own basic knowledge of chemistry will all welcome this new edition of Deming's *Fundamental chemistry*.

This book is truly a worth-while one and may be read with profit by teacher and student alike. It is logically written in a prose which is easy to follow and understand. It is orderly in its presentation and accurate in its information. It is thoroughly modern in its thesis, its approach, and its treatment of theory and fact. It is designed to present chemistry as a "manner of thinking" rather than as a "collection of facts," and to this end it encourages the student to thought through well-chosen questions, problems, diagrams, and illustrative examples.

Although addressed primarily to the chemistry major and to the individual who has some previous knowledge of the subject, the book can be adapted to others by limiting assignments to indicated selected topics. Theoretical concepts are presented gradually in conjunction with factual material, although treatment of the latter is much less comprehensive than in the ordinary beginning textbook, particularly with regard to the metallic elements. The book contains much explanatory information beyond that contained in most elementary treatments and is to be commended for its stress upon rigid definitions and its dimensional and reasoning approach to problems.

The book is free from significant errors.

THERALD MOELLER

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Visible speech. Ralph K. Potter, George A. Kopp, and Harriet C. Green. New York: D. Van Nostrand, 1947. Pp. xvi + 441. (Illustrated.) $4.75.

This book is a record of the work of the Bell Telephone Laboratories in converting speech sounds instantaneously and continuously into readable visible patterns.

The first section of the book briefly and nontechnically describes the "Direct Translator," which produces the pattern from the sound, and states that a group practiced with the instrument is able to communicate vocally among its members totally without benefit of hearing.

The second section comprises 225 pages of superbly illustrated and illuminated lessons in the art. More than 500 cuts illustrate "vocabulary" and tie the patterns to the vocal mechanisms which produce the sounds.

A third section (154 pp.) considers the principles of Visible Speech in relationship to such fields as speech correction and indicates its use in teaching vocal speech to the totally deaf. Some space is also taken up with cuts of the singing voice and even of instrumental music.

The book will be of interest to every student of speech and speech correction. It illuminates the mechanics of vocal sound production exceptionally well and completely.

Two of its authors are practiced speech teachers; the third, an engineer. In style it is nontechnical and exceedingly readable.

T. E. LYNCH

The Brush Development Company, Cleveland, Ohio

Glacial geology and the Pleistocene epoch. Richard Foster Flint. New York: John Wiley; London: Chapman & Hall, 1947. Pp. xviii+589. (Illustrated.) $6.00.

According to the Preface, this book presents the principal facts of glacial geology and the Pleistocene epoch in compact form for geologists, ecologists, archaeologists, geographers, soil scientists, and other students of the Pleistocene. It is a summary of established data for the entire globe, and it indicates areas in which research is greatly needed.

The 23 chapters may be grouped as follows: (1) Summary; (2) The nature and properties of existing glaciers; (3) The nature of the record left by previous glaciers of the Pleistocene; (4) Glaciation of North America; (5) Glaciation of Europe; (6) Glaciation outside North America and Europe; (7) Relations between glaciation, mountain uplifts, changes in level of land and sea, former great lakes in dry continental areas, and the migrations of animals and plants; and (8) The relation of climatic fluctuations to glaciation.

This simplified table of contents does not give any idea of the wealth of detail in the book. Approximately 1,000 titles, of which about 17 per cent are in languages other than English, are listed in the bibliography. There are 30 tables, 20 photographs, 30 diagrams, and 40 maps, of which 6 are folded plates at the back of the book. The reader will wish to refer, in addition, to the large Glacial Map of North America (Flint, *et al.*, 1945), published separately by the Geological Society of America.

The author goes into considerable detail concerning a definition of the term Pleistocene, and his suggestion that the terms Tertiary, Quaternary, Recent, and Postglacial be dropped from formal nomenclature.

Yet this is more than a reference book. It is written with enthusiasm and makes interesting reading. One feels oriented at the same time to the achievements of glacial geologists during the last 100 years and to the prospect of further research to fill in the enormous gaps in our knowledge of the Pleistocene epoch. The reader is impressed with the fact that the Wisconsin Glacial Age is a present and continuing reality.

It is a satisfaction to note that the book is dedicated to the memory of the young glaciologist, Max Demorest (1910–1942).

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The Discovery of Aptitude and Achievement Variables

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THE PROGRESS MADE IN APTITUDE testing in the Army Air Forces during the recent war has already been discussed in *Science* (*2*). The brief account to follow is written with the belief that the general reader will also be interested in some of the fundamental scientific gains incidental to the AAF Psychological Program, or, more specifically, the gains in understanding the *nature* of human resources.

Under pressure of the urgent emergency during the first months of the war, the traditional approach to the development of aptitude tests for the selection and classification of pilots, bombardiers, and navigators was followed. Job analyses were made, with attempts to break the performances of men in specialized jobs into distinguishable and significant psychological functions. Tests attempting to assess those functions were constructed, and a certain degree of success was achieved. As data accumulated, however, it was recognized that the job-analysis categories were of little value in revealing why some tests were valid for the selection of good trainees, why others were not, and why some pairs of tests which appeared to be quite dissimilar exhibited substantial degrees of intercorrelation. Recourse was made to the application of factor-analysis procedures, and it soon became apparent that in this direction lay not only the answers to many puzzling questions concerning specific tests but also the general frame of reference for an enlightened test development program.

Factor theory conceives of human personality (in more operational terms, individual differences) as being economically describable by reference to a limited number of distinguishable dimensions. These fundamental variables are not readily observable by ordinary procedures because of their intricate and varied manifestations in human behavior, including that part of behavior seen under more standardized conditions, the psychological test. Tests correlate with one another to the extent that they measure in common one or more of the underlying variables or factors. From the high, low, and moderate degrees with which tests intercorrelate, the common factors can be detected by statistical operations. The attachment of psychological meaning to a factor depends upon the apparent common features of the behaviors that are symptomatic of it and upon the insight of the investigator. Several methods have been proposed for the factoring of a correlation matrix (intercorrelations among a collection of tests). Experiences of the AAF psychologists led to the adoption of the Thurstone centroid method of extracting factors, followed by the rotation of reference axes into a positive manifold and simple structure, as being the most fruitful procedure (*4*). Intelligibility and reproducibility of factors and of factor loadings in tests were thus best achieved.

It is the purpose of this brief account merely to list and to define partially the factors revealed in the AAF. Verifications of previously discovered and substantiated variables, which, in tests of aptitudes, Thurstone has called "primary abilities," (*5*) will be mentioned first. These will be followed by a list of factors which, by their repeated verification in the AAF, can be proposed as serious contenders for recognition and by a much longer list of newcomers, the existence and identities of which require further verification.

Prewar factors verified in the AAF include:

(1) *Verbal.* This is easily verified in any test that involves individual differences in the understanding of the meanings of words. Vocabulary tests are the strongest and purest measures of it—a fact not generally accepted previously. Reading-comprehension tests have their strongest loading in this factor, but they are also usually related to others in moderate or small degree.

(2) *Numerical.* The strongest and purest tests of this factor require nothing except speed and accuracy in the four numerical operations. It tends to creep into almost any test in which numbers must be used by the examinee, not only by way of fundamental operations but also in noting number size, rank order, and the like. Its exact limits are still to be determined.

(3) *Perceptual speed.* This should more strictly be denoted as "visual-perceptual speed," for it has been observed only in visual tests. The quick, yet accurate, grasping of visual details, features, similarities, and differences seems to characterize tests heavily loaded in it. Pure tests of this factor are rather easy to achieve.

(4) *Associative memory.* Thurstone named what is probably the same factor "rote memory." This is found in tests requiring the memorizing of elements—letters, words, numbers, pictorial objects—in pairs and a later associative recall. The elements may be meaningful or nonsensical.

(5) *General reasoning.* This term is an admission of failure to identify more exactly the factor which appeared in a larger number of reasoning tests than any other reasoning factor. The test that most consistently leads in this factor is that of arithmetic reasoning. It is not a mathematical-reasoning factor, however, for it is found

in nonmathematical tests. In the AAF results there is little to support the traditional distinction between inductive and deductive reasoning abilities. No reasoning test was pure in any factor. Since all tended to be factorially complex, definitions of the three reasoning factors could not be achieved. One hypothesis is that the general-reasoning factor represents a diagnostic ability—the ability to grasp the nature of problems.

The next factors are fairly well verified. Only one (visual memory) has a clear prewar counterpart.

(6) *Spatial relations.* One of the most significant AAF findings was the separation of this factor and the next one, called *visualization.* It seems quite clear that prewar results had confused the two. Thurstone called his primary ability in this area "space," but he defined it as if it were visualization (*5*). The space factor, as here defined, is found in psychomotor tests as well as in printed tests. It seems to be a perceptual awareness of the arrangements of objects with respect to right-left, up-down, and out-in dimensions. Correct choice as to direction of movement in some psychomotor tests depends upon it.

(7) *Visualization.* This factor, which should probably be modified to "manipulatory visualization," is prominent in tests requiring one to imagine transformations, movements, or other changes. A typical test presents a picture of a square paper being folded one or more times, in successive steps, and a hole of a given shape being cut out. The examinee selects one of five other pictures, each showing plausible creases and holes, as the paper might appear after being unfolded.

(8) *Mechanical experience.* The AAF analyzed almost every type of so-called mechanical tests. Printed tests often designated as "mechanical" showed, depending upon the test, moderate loadings in perceptual speed, spatial relations, and visualization. Many of them showed loadings in a factor which compelled the conclusion that its existence depends heavily upon learning —hence the factor name, "mechanical experience." Tests of mechanical information (stressing knowledge of tools and automobile parts and their functions) are almost unique in this factor. The popular term "mechanical aptitude" covers a rather loose collection of things and, when used, should be carefully scrutinized. Mechanical jobs vary all the way from tinkering with clocks and operating a steam shovel to designing a bridge. Each job, though called "mechanical," probably has its unique pattern of requirements in terms of human resources.

(9) *Length estimation.* Probably the best test of this factor is one requiring a simple and direct comparison of the lengths of lines. The factor also appears in tests involving objects of more than one dimension. Its degree of generality has not been determined.

(10) *Visual memory.* This factor, which seems to be a purely reproductive type of memory for visual patterns, can probably be identified with a similar factor found by Carlson before the war (*1*). It is found in recognition tests as well as recall tests and might be regarded as a second and independent type of visualization. Both this and the manipulatory-visualization factor would be expected to depend upon the visual cortex, and in view of their independence, one should look for two distinct corresponding properties of that cortex. In this connection, one is reminded of the distinction made in two types of eidetic imagery—rigid and plastic.

(11) *Judgment.* Job analysis, of the pilot's work in particular, stressed the paramount importance of what is popularly known as "common-sense judgment." Tests called "practical judgment" were therefore constructed. These presented items in the form of verbally described predicaments such as those a service man might encounter, each with five more or less plausible solutions, one of which was regarded as the wisest under the circumstances. Analysis of such tests showed significant loadings in the verbal factor, in general reasoning, and in the mechanical-experience factor. (Knowledge of common tools and materiel was apparently useful to the examinee in this kind of test.) Over and above these variables common to the practical-judgment tests, there was additional communality which could be called judgment. While it was characteristic of judgment tests as a class, it was also common to tests calling for practical estimations of sizes, times, and distances in everyday situations and to some tests of planning. It may actually be a fourth kind of reasoning—that is, reasoning of a judicial or critical type. It is probably a factor that is almost entirely missed in most intelligence tests, which supports many a layman's view that common-sense judgment is not covered by the IQ.

(12) *Psychomotor coordination.* This factor is common to various psychomotor tests, including those requiring coordinations of fingers and hands (finger dexterity), of arm and shoulder (rotary pursuit), and of arms and legs (using mock airplane controls). It is doubtful whether it can be identified with the agility factor found in such physical education tests as the dodge run. It is quite possible that there is a coordination factor other than this one which is restricted to the finer finger movements.

The remaining factors are merely suggestive of worth-while hypotheses.

(13) *Psychomotor precision.* This was found to be common to a finger dexterity test, a discrimination-reaction time test that required rather accurate aiming at the reaction keys, and the pass-fail criterion in bombardier training. It is hoped that the naming is more than a figure of speech in its association with precision bombing!

(14) *Psychomotor speed.* This appeared in only two rather unique paper-and-pencil tests in which the rate of marking an answer sheet was important. It strongly

suggests a prewar factor in similar tests, such as the 'speed of making "gates" (tally marks). Little more can be said of it at this time. Hypothetically, it would be important in the more simple, repetitive tasks of motor performance.

(15–16) *Reasoning II and reasoning III.* These two factors arose rather weakly in a number of factorially complex tests. Clues for hypotheses are seriously lacking. Reasoning II is prominent in analogies tests and the hypothesis of "reasoning-by-analogy" is tempting, but it also appears in other tests not obviously having this quality. Reasoning III is strongest in two tests, one of which seems to call for inductions (seeing systems in arrangements of lines) and one for deductions (deciphering a code). The finding of at least three distinct reasoning factors suggests that the term "reasoning" conceals a number of unrecognized functions. Some of these may be primarily biologically determined, but others may be in the form of reasoning habits brought about under educational pressures, formal or otherwise. Until the variables are better identified in this area, studies of training in thinking and of the problems of formal discipline cannot be adequately effected.

(17–18) *Space II and space III.* These factor names are not only very general but also highly tentative. Space II is prominent in two of Thurstone's space tests involving the ability to recognize from pictures of human hands held in varied positions whether each picture is of a left or a right hand, in the one, and the ability to tell whether two U. S. flags, as pictured, show the same or the opposite sides, in the other. One hypothesis is that kinesthetic imagery plays a role in the solution of such items for some individuals. There is no suitable hypothesis to offer for space III.

(19–20) *Memory III and memory IV.* A third memory factor was strongly common to two tests. The task was one of paired associates in which names were memorized for objects: airplanes in one test and outline lakes, rivers, and bays in the other. These tests also had in common the more general associative-memory factor previously mentioned. This fact, taken together with that of several reasoning factors, suggests the possibility of hierarchies of factors within an area of mental functioning, with different levels or different degrees of generality, or both. It would seem that, although such functions are statistically independent or at least separable, they quite commonly operate conjointly in behavior. Memory IV is named as such with considerable hesitation. It could be defined as memory for verbal instructions or, generalizing somewhat, as memory for verbal content. This factor was found in a small number of tests having in common intricacy of instructions and tasks. Forgetting any part of the directions while attempting an item might well result in failure on the item. The tests were designed to see how well the prospective pilot could "keep in mind" a number of things that had to be taken into consideration in performing a task. One memory test (called Memory for Tactical Plans), which consisted of a quizzing two hours later on a briefing given orally for a mock military mission, although not analyzed along with the tests just mentioned, was known to have an unknown factor or factors related to the criterion of pass-fail in pilot training over and above factors already accounted for. It is a reasonable hypothesis that "memory for instructions" is common to this test and those known to be loaded in memory IV.

(21–22) *Mental set I and mental set II.* The first is strongest in tests of following directions when these keep changing as the examinee proceeds. There is little for the examinee to remember for very long. The significant variable seems to be an adaptability to changing rules. It is not a matter of flexibility of set, in a sense opposite to perseveration. Explicit attempts to bring out an expected common factor of perseveration in a number of tests definitely failed. Mental set II seems to represent a breadth-of-set quality. Attention to details, overlooking none, seems relatively important. The tests in this cluster are tedious, exacting tasks. Whether definition of the factor should emphasize breadth or care in handling details is an open question.

(23) *Carefulness.* This and the next factor seem to be temperamental or motivational variables rather than abilities. It was hypothesized that navigators must exercise extreme care with details in their work, for small mistakes become magnified in terms of miles-off-course and errors in estimated time of arrival. Four tests of a complex, clerical type were devised to study this hypothesis. Analysis of the scores based upon the number of items correct yielded some of the already familiar factors in significant amounts—number, visualization, and space. The scores based upon the number of errors made, however, had in common a new factor which could very reasonably be called carefulness. Its possible relations to mental set II have not been investigated. This might be denoted as "meticulousness," a personality trait that has already been given some attention by clinical psychologists. Of great general importance in this finding is the fact that error scores and correct responses may measure something very different. It has generally been assumed that "rights" and "wrongs" in a test measure the same functions in reverse direction. The finding opens the door to a promising line of new research.

(24) *Pilot interest.* From the finding of this unity in behavior, one is led to the conclusion that our culture has molded an interest variable centering around piloting an airplane. It seems not to be a general aviation interest, and no similarly crystallized interest variables for navigation or for bombardiering were noted. The pilot-interest factor was revealed in general-information tests (which included items on knowledge

of airplanes and their operation) and in a biographical-data test score that was valid for pilot selection. This test called for facts concerning the examinee's previous flying experience, hobbies, and the like.

(25) *Mathematical background.* This is common to the biographical-data test as scored for the selection of navigators and to mathematics-achievement tests (including algebra, with some trigonometry and analytical geometry). It has no relation to numerical-operation tests or to arithmetical-reasoning tests. Like the mechanical-experience factor, it seems to be a culturally determined unity in individual differences.

(26) *Social-science background.* This is mentioned with extreme hesitation because it was revealed in conjunction with only two tests—information tests in history and geography. The only other supporting evidence, (and it is quite slender) is that this factor correlates slightly negatively with the pilot criterion, which is also true of biographical indications of specialization in the social sciences. This hypothesis suggests the question of whether there is also a physical-science background factor. Since only one field of physical science—physics—was examined in aviation students, this hypothesis could not be tested.

(27) *Planning.* The name of this factor is adapted from the planning tests, in which it is unique. One test of this kind required the examinee to tell in which order he would make the strokes of two successive letters if he were skywriting with an airplane. Another called for the most economical order for a series of errands to be performed in a city whose layout is pictured. This factor might possibly be another kind of visualization, but, unlike the manipulatory visualization, it calls for more of a creative contribution. It is distinct from the judgment factor, although both may occur in the same tests.

As a general consideration, there is always the question of whether factors are completely independent or correlated to some degree. Almost exclusively, orthogonal frames of reference were used in the AAF for describing factor configurations. There seemed to be no evidence of very significant correlations among the factors. The matter has recently been given some attention. There are probably some small correlations among some of the intellectual and perceptual factors. An interesting, slight, negative correlation appeared between the number factor and the mechanical-experience factor. The probable reasons for this are not hard to surmise.

The list of factors is probably longer than many would expect, and yet it is certainly not exhaustive. The fact that other previously reported factors did not emerge should not be taken as evidence against their existence. The absence of a universal or "g" factor in Spearman's sense, however, is a significant outcome.

The list throws into bold relief the limitations of intelligence tests and the IQ. These ordinarily stress most heavily the verbal, general-reasoning, and numerical factors, probably in that order, with sprinkling contributions of space, visualization, and memory, depending upon the test. The IQ, as derived from different tests, is not a constant article by any means. IQ tests would have been almost useless in selecting pilots from among those with IQ's of 100 and above, had mastery of flying training been the criterion. On the other hand, it was estimated that the pilot criterion leaned most heavily upon such resources as spatial relations, mechanical experience, psychomotor coordination, pilot interest, and perceptual speed, with minor dependence upon about 15 of the other factors in the list. Even then, with all these factors optimally weighted in a composite aptitude score, less than 60 per cent of the variance in the pilot criterion would be accounted for. Within the limitations of the reliability of the criterion itself, perhaps as much as 80 per cent could be predicted if all pertinent factors were included in the aptitude composite (*3*). Before the war, a selective test or battery would have been regarded as relatively successful if it accounted for as much as 30 per cent of the variance in a practical criterion.

The vocational implications of all this are quite clear. Fitting individuals to educational and vocational plans presents a much more complicated problem than has heretofore been supposed. The chief hope for a solution appears to lie in the direction of the use of factorial thinking and practice. Persons, tests, and jobs can all be described in terms of the same reference frame—one with which many can agree because it is derived in an operational manner. Not only aptitudes, whether biologically or culturally conditioned, or both, but also temperamental and other personality traits can be translated into the same types of categories. It is probable that substantial gains in the assessment of all aspects of personality await such an approach. It is also probable that controlled fundamental research on other problems of human nature awaits the identification of its real variables.

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Educational Programs at Research Centers

Rawson Bennett, Captain, USN
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THE ACUTE SHORTAGE OF COMPETENT scientific personnel, which endangers the research and development programs of the Nation, has been the subject of considerable discussion. An interesting summary of several factors affecting research and some noteworthy suggestions for measures to improve conditions were presented by Charles V. Kidd in the January 24 issue of *Science*. However, this article failed to mention the steps that can be taken at industrial or government research centers to improve the competence of personnel through educational programs within the centers.

In a later issue (May 2), Kenneth A. Meade stated the case of the industrial concern very comprehensively and in considerable detail. In general, his conclusions and comments are very appropriate. For example, the staff at this Laboratory heartily agrees that the essential training to be given by educational institutions should consist of a good grounding in the fundamentals. One point of possible disagreement is Meade's conception that the educational institution can help a young man finally determine whether his interests lie in engineering, teaching, or sales work. Actual work on a job is frequently required to make this determination.

The experience of the Navy Electronics Laboratory in inaugurating and carrying out a program of in-service education may be of interest to others. This program appears to have helped not only in overcoming some of the deficiencies in the backgrounds of available personnel but also in aiding those who are uncertain as to their fields of work to decide on a course of action. Although somewhat simpler of accomplishment in a government research and development center, it is believed that the program, which is based on the good democratic principle that "the Lord helps those who help themselves," is not inapplicable to industrial groups.

A survey showed requirements at four levels. First, there was a need for interchange of scientific knowledge and ideas between more experienced and less experienced scientists at the Laboratory on a general, rather than a work assignment, basis. Second was the requirement for upper-division, college-level courses to afford opportunity to promising younger men to finish undergraduate instruction. There was also the need of older men to extend their knowledge into new fields. Third, men working for higher degrees required assurance of opportunity. Fourth, and most important, was the necessity of tapping the knowledge of eminent scientists in special fields.

The whole in-service educational program is loosely integrated by the Educational Board of senior scientists, which is also responsible for direct action on the more formal portions of the program. The Educational Board also attempts to cover one or two other points raised by Meade. For example, it can advise and all but direct younger men to undertake certain courses of instruction, and it can also discourage those who are ill fitted for other courses in the interest of keeping classes at convenient working size.

The exchange of information and ideas between staff members takes place in two fashions. Several departments operate seminar series, on the basis of mutual contribution of effort. The visits of outside scientists and senior staff members are also seized as opportunities for scientific "bull sessions" with all members of a group contributing.

Regular courses are given that range from straight undergraduate work to graduate-level seminars.

Generally speaking, undergraduate classes are handled by the University of California's Extension Division. Some of the upper-division and graduate courses are given by staff members and some by visiting consultants. These courses and teachers are cleared with the University of California at Los Angeles. By this method, and through arrangements with the Graduate School of the University, staff members acceptable to the Graduate School may obtain graduate credit for such accredited courses taken at the Laboratory. This encouragement of further graduate work has been strongly and enthusiastically supported by the younger men and women of the Laboratory.

It has been found impracticable to establish fixed rules for time scheduling of courses Instead, each one is considered on its merits, depending upon the direct applicability to Laboratory work, benefits to individuals, and other factors. As a result, some instruction is given during working hours, some out of working hours, and some overlaps at the end of the day.

The most interesting and unique part of the program is that filled by the visiting consultant. Leading scientists of known and outstanding ability in fields related to, or directly in line with, the work of the Laboratory are brought in for limited periods to act as consultants and instructors.

In the role of consultant, the visiting scientist contributes both directly and indirectly to the work of the Laboratory. In some cases he may assume a definite problem in research or development during his residence, planning an investigation and supervising the work of staff scientists. If the project is small, he may complete the investigation during his stay. If the problem involves long-term research, he will plan and organize a program which will be carried on by Laboratory men. The visitor is, therefore, directly responsible for a portion of the research program. He also makes direct contributions, sometimes accidentally, to other related investigations. For example, the informal discussion by a visiting scientist of a new method of mathematical analysis saved two months of work for the Laboratory. The technique, hitherto unknown, was applied to a problem and the solution obtained immediately. The long analysis program previously planned was cancelled.

Instruction may be handled in several ways. The visiting scientist may present a series of lectures covering some specialized field, ordinarily at college upper-division or graduate level. He may, in addition, present even more specialized material, usually the result of his own research, to a smaller group in seminar-type meetings.

The benefits to the Laboratory are obvious, and the program is effective in several ways. The younger staff members have an opportunity not only to increase their knowledge in the basic principles and methods necessary to the conduct of their work but also to learn new techniques and developments. Those scientists directing the research and development program of the Laboratory can learn firsthand the status of research being conducted by other organizations in allied fields. The wider the knowledge and the greater the ability of the staff scientists, the sooner will the research problems be solved. These benefits are not always measurable, but examples of concrete results are frequent. In one case, a research problem assigned by the Bureau of Ships was solved by applying certain newly discovered principles to previously collected data, and a tedious experimental period was avoided. The solution, later checked by a brief series of experiments, proved correct. This was possible only because a visiting scientist had explained the new principles in a series of lectures given several months before assignment of the problem. The Laboratory scientist, by referring to his notes, was able to apply the new information to his data, thus effecting a considerable saving in time and money.

The indirect influence of the visiting scientist, though generally intangible and difficult to identify, is perhaps his most valuable contribution. The spontaneous interchange of ideas among scientists is the best stimulus for scientific progress. The effect on Laboratory personnel of the different outlook, attitude, and ideas, as well as the wide knowledge, of the visiting scientist can only be described as inspirational. Its value to the Laboratory lies in the increased potential ability of the staff scientist rather than in the solution of specific problems.

Many of the results of this program are, of course, of benefit to the visitors as well as to the Navy Electronics Laboratory. The visitors have an opportunity to review much of the Laboratory's program, to discuss their own research problems with staff scientists, and to use the extensive Laboratory facilities for experimental work.

This advanced educational program began in the summer of 1946. The Navy Electronics Laboratory was fortunate that the first scientists to visit the Laboratory as consultant-instructors were R. B. Lindsay, chairman of the Physics Department, Brown University, and S. A. Schelkunoff, of the Bell Telephone Laboratories. Prof. Lindsay lectured on wave motion with particular application to acoustics and radio, while Dr. Schelkunoff gave a series of lectures on special topics in applied mathematics of considerable importance in wave propagation and radiation from antennas. After several conferences and symposia, both scientists were able to make many suggestions of value to present and future investigations.

W. G. Cady, of Wesleyan University, visited the Laboratory from the latter part of February to April of this year, presenting one series of lectures on "Piezoelectric Theory" and another on "Transducer Design." During the summer, Henry Margenau, of the Physics Department, Yale University, presented a course on "The Mathematics of Physics and Engineering" and also offered a seminar on "Transmission of Microwaves Through Gaseous Media." The subject matter covered by these men, both authorities in their fields, has direct and immediate application to the work of the Laboratory.

Every effort is being made to schedule visits of others in a similar capacity during future sabbatical leaves or summer vacations. Present plans include a course on "The Kinetic Theory of Gases" by Leonard B. Loeb, Department of Physics, University of California, Berkeley.

In the future, it is planned to improve continually the available educational opportunities at the Navy Electronics Laboratory. There is no reason why, eventually, the point cannot be reached at which a stimulating atmosphere of learning and free discussion exists throughout the Laboratory to the same degree as at academic institutions, where much smaller scientific groups working in close collaboration make such an ideal situation more easily attainable.

Meade has, further, raised the point that technical schools must be furnished with pertinent information on the policies, management philosophies, and attitudes expected of graduates employed by various institutions. The Navy Electronics Laboratory has recently published a brochure, covering these fundamental points and many others, which has been given wide distribution to educational institutions. It is hoped that, in addition to its uses in recruiting personnel, this information will be helpful to these institutions.

It is the firm conviction of the staff that all of this effort is worth while. The scientific stature of individuals at the Laboratory will be increased, and the whole program of the Laboratory will benefit. In addition, some small contribution to the scientific manpower resources of the country will be made through the encouragement of the younger men.

NEWS
and Notes

Seven of the Nation's leading scientists have recently been appointed by the U. S. Atomic Energy Commission to membership on an Advisory Committee for Biology and Medicine. Chairman of the group is Alan Gregg, director for medical sciences, Rockefeller Foundation, who will be assisted by G. W. Beadle, chairman, Division of Biology, California Institute of Technology; Detlev W. Bronk, director, Johnson Research Foundation, and chairman, NRC; Ernest W. Goodpasture, dean, School of Medicine, Vanderbilt University; A. Baird Hastings, professor of biochemistry, Harvard Medical School; E. C. Stakman, chief, Division of Plant Pathology and Botany, University of Minnesota; and Joseph T. Wearn, dean, School of Medicine, Western Reserve University.

Among the tasks confronting the Committee are the nomination of a director of the Commission's proposed Division of Biology and Medicine; a study of basic policies which the Commission should follow with respect to the biological, medical, and health physics aspects of its program; a study of possible ways of utilizing an appropriation of $5,000,000 for cancer research; and formulation of plans for carrying out the long-range recommendations made to the Commission by the Medical Board of Review. The latter include such problems as extension of research and training in the application of atomic energy to medical and biological problems; health hazards; continued provision of isotopes for research purposes as well as provision of a consulting service for investigators; publication of scientific papers; coöperation between the Commission and other agencies of the Government with respect to fundamental research and the training of personnel; and provision of fellowships in the field of radiation effects.

A partial list of headquarters assignments for the sections and societies that will meet with the AAAS at Chicago, December 26–31, 1947, is given below. The Sherman Hotel will be the general headquarters for the convention.

Congress Hotel: American Association of Economic Entomologists, American Microscopical Society, American Society of Naturalists, American Society of Parasitologists, Beta Beta Beta, Ecological Society of America, Entomological Society of America, Phi Sigma Society (Council only), Society for the Study of Evolution.

Palmer House: Section B (Physics), Section O (Agriculture), American Association of Physics Teachers, American Dietetic Association, American Meteorological Society, American Physical Society, American Society for Horticultural Science, Honor Society of Phi Kappa Phi, Philosophy of Science Association, Pi Lambda Theta, Potato Association of America, Sigma Pi Sigma, Society for Research in Child Development.

Sherman Hotel: Section A (Mathematics), Section C (Chemistry), Section D (Astronomy), Section E (Geology and Geography), Section H (Anthropology), Section I (Psychology), Section K (Social and Economic Sciences), Section L (History and Philosophy of Science), Section M (Engineering), Subsection Nd (Dentistry), Subsection Nm (Medicine), Subsection Np (Pharmacy), Section Q (Education), Academy of World Economics, American Chemical Society (Chicago Section), American Nature Study Society, Cooperative Committee on Science Teaching of AAAS, National Association of Biology Teachers, National Science Teachers Association, Pi Gamma Mu, Research Council on Problems of Alcohol, Sigma Delta Epsilon, Society of the Sigma Xi.

Stevens Hotel: Section F (Zoology), Section G (Botany), American Fern Society, American Phytopathological Society, American Society of Plant Physiologists, American Society of Plant Taxonomists, American Society of Zoologists, Botanical Society of America, Inc., Genetics Society of America, Herpetologists League, Limnological Society of America, Mycological Society of America, Sullivant Moss Society.

Receipt of back issues of *Science* for the entire year 1947 from members of the AAAS who do not maintain permanent files would be greatly appreciated (see *Science*, May 16). Those especially needed at the the moment, however, are Nos. 2717 through 2726, 2728, 2730, 2731, 2733, 2734, and 2740 through 2742. The issues should be sent by second-class mail to: American Association for the Advancement of Science, 1515 Massachusetts Avenue, N. W., Washington 5, D. C. Postage will be refunded.

About People

Marian Balicki, of the Polish University College, London, has been appointed assistant professor of mechanical engineering at the Polytechnic Institute of Brooklyn. Dr. Balicki last spring was awarded the Andrew Carnegie Silver Medal for research on work hardening and recrystallization of Armco iron.

Angel Cabrera, professor of zoology, University of Buenos Aires, and **Rudolph M. Anderson**, curator of Mammals, emeritus, National Museum of Canada, were elected to honorary membership in the American Society of Mammalogists at the 27th annual meeting of that organization.

Harvey S. Moyer, professor of chemistry, Ohio State University, has been appointed an assistant dean of the Graduate School. Dr. Moyer will devote half time to his new duties.

Lt. Col. George W. Hunter, III, formerly chief, Department of Parasitology, Army Medical Department's Research and Graduate School, Washington, D. C., is now serving a tour of duty overseas, having been assigned as chief of the Section of Medical Zoology, 406th Medical General Laboratory, located in Tokyo, Honshu, Japan.

Eugene L. Lopez, a member of the University of Illinois staff since 1937, has been appointed director of clinics at the University of Illinois Hospitals.

Herman V. Tartar has been appointed executive officer of the Department of Chemistry and Chemical Engineering, University of Washington, Seattle. A member of the staff for 29 years, for the past 5 years he has served as director of the laboratories.

William A. Perlzweig, professor of biochemistry, Duke University School of Medicine, has received three months leave to visit Palestine, where he will act as special adviser to the Hebrew University and the Hadassah Medical Organization in the proposed establishment of a medical school in the University of Jerusalem.

David F. Miller, professor of zoology, Ohio State University, has been named chairman, Department of Zoology and Entomology, which embraces zoology, entomology, genetics, and conservation. Dr. Miller succeeds **Laurence H. Snyder**, recently named dean of the Graduate School, University of Oklahoma.

A. Starker Leopold, Frank A. Pitelka, and **Ralph I. Smith** have been promoted to assistant professorships in zoology at the University of California, Berkeley.

Irvine McQuarrie, head, Department of Pediatrics, Medical School, University of Minnesota, has been commissioned by the Rockefeller Foundation to make a three-month survey of the status of medical education and the standards of medical practice in postwar Japan. He left for the Orient by plane September 16.

George B. Barbour, dean, College of Liberal Arts, and professor of geology, University of Cincinnati, has recently shown that caves at Makapan, near Johannesburg, South Africa, are similar in formation and deposits to those once inhabited by China's prehistoric Pekin Man. As a result of Dr. Barbour's investigations, the University of California is preparing to send an expedition which will open its research at Sterkfontein where the Transvaal Sterkfontein Man was discovered by Robert Broom. The expedition hopes to recover in the Makapan Caves the remains of men living there more than 250,000 years ago. Stone implements, animal bones, and a stone hearth have already been uncovered there.

Lloyd M. Bertholf, since 1924 professor of biology and since 1939 dean of the faculty at Western Maryland College, Westminster, Maryland, has accepted the deanship of the College of the Pacific, Stockton, California, effective February 1, 1948.

Col. Marshall Stubbs has been appointed deputy chief, and **Maj. Claude W. White** executive officer, of the Research and Engineering Division, Army Chemical Center, Maryland, according to an announcement by Col. Charles E. Loucks, chief of the Division. This Division directs and coordinates the research and development program of the Chemical Corps. In addition to work on chemical agents, the research program includes the development of smoke, incendiary, weapons and munitions, protective devices, and all countermeasures in these fields.

David L. Taylor, Department of Botany, University of Chicago, has been appointed assistant professor of botany at the University of Illinois.

Erich Lindemann, psychiatrist, Harvard Medical School, has been appointed to the Harvard University Faculty of Arts and Sciences to assist in broadening the scope of the new Department of Social Relations, established last year to break down the limitations of individual departments in working on common problems of social relations. Dr. Lindemann will continue as a member of the staff of Massachusetts General Hospital.

Percival Bailey, neurologist, University of Illinois, has been promoted to distinguished professor of neurology and neurological surgery, becoming the second faculty member of the Chicago Professional Colleges to hold the distinguished professor rank.

During the summer session at Northwestern University, completed August 23, **William N. Fenton**, senior ethnologist, Bureau of American Ethnology, Smithsonian Institution, lectured on primitive political organization, and **C. F. Voegelin**, professor of anthropology and chairman of the Department at Indiana University, taught linguistics. Both visiting professors taught general anthropology. Dr. Fenton resumed his regular work at the Bureau of American Ethnology on September 15, after a brief field trip among the Seneca Indians of western New York; he is currently senior editor of the *Journal of the Washington Academy of Sciences*. Dr. Voegelin, who has returned to Bloomington, edits the *International Journal of American Linguistics*.

Harry L. Fevold, head, Pharmaceutical Food Proteins and Food Lipids Section, Biochemical Division, Western Regional Laboratory, U. S. Department of Agriculture, Albany, California, has been appointed chief, Product Development Division, Quartermaster Food and Container Institute for the Armed Forces, Chicago.

Samuel R. Tipton, associate professor of physiology, Medical College of Alabama, has been appointed professor of zoology, University of Tennessee.

Edward B. Tuohy, formerly associate professor of anesthesiology, Mayo Clinic, has been appointed professor of anesthesiology, Georgetown Medical Center, Washington, D. C.

Ray T. Wendland, assistant professor of chemistry, Lehigh University, has been appointed professor of chemistry, Organic Section, North Dakota State College.

Grants and Awards

Arpad L. Nadai, consulting engineer of the Westinghouse Research Laboratories, has been awarded the Worcester Reed Warner Medal by the American Society of Mechanical Engineers. The medal, which is given for noteworthy contributions to the permanent literature of engineering, will be presented at the Society's annual meeting in Atlantic City in December.

Van R. Potter, McArdle Memorial Laboratory for Cancer Research, University of Wisconsin, received the $1,000 Paul-Lewis Laboratories Award in Enzyme Chemistry at the recent meeting of the American Chemical Society for his contributions in the field of respiratory enzymes.

Nominations are solicited for the 1948 Award of $1,000 established by Mead Johnson and Company to promote researches dealing with the B-complex vitamins. The recipient of this award will be chosen by a Committee of Judges of the American Institute of Nutrition, and the formal presentation will be made at the annual meeting of the Institute in the spring of 1948.

The award will be given to the laboratory (nonclinical) or clinical research worker in the United States or Canada who, in the opinion of the judges, has published during the previous calendar year the most meritorious scientific report dealing with the field of the B-complex vitamins. While the award will be made primarily for publication of specific papers, if circumstances and justice so dictate, it may be recommended that the award be made to a worker for valuable contributions over an extended period, but not necessarily representative of a given year. Membership in the American Institute of Nutrition is not a requisite of eligibility. Nominations for this award for work published in 1947 must be in the hands of the Nominating Committee by January 10, 1948, and should be accompanied by such data relative to the nominee and his research as will facilitate the task of the Committee of Judges. E. N. Todhunter, University of Alabama, University, Alabama, is chairman of the Nominating Committee.

At the opening sessions of the World Conference of the International Federation of University Women, August 12, in Toronto, the following recipients of awards were named: The international fellowship in senior science ($300) went to E. J. Batham, Otago University, New Zealand, to continue research in zoology at the University of Cambridge; the Helen Marr Kirby Fellowship, to G. F. E. M. Dierick, University of Amsterdam, who will continue studies in the chemical control of citrus pests in California; the International Fellowship, to Mrs. H. Zwirn-Hirsch, Hebrew University, Jerusalem, who will continue research in fungi in California; and an award to L. C. Roubert, chemist, Algiers University, who will work on blood proteins at Harvard Medical School.

The American Cancer Society has made a grant of $10,000 for the support of special research on the growth of cancer cells to the Tissue Culture Laboratory, University of Texas Medical Branch, Galveston, which is under the direction of Charles M. Pomerat.

Claude E. Zobell, professor of microbiology, Scripps Institution of Oceanography, has been awarded a special fellowship by the Rockefeller Foundation which provides for a year of travel and study in European research laboratories.

Colleges and Universities

A new course in the colloid chemistry of silicon is being established this fall at Massachusetts Institute of Technology. This course, which will be under the direction of **Ernst A. Hauser,** associate professor of chemical engineering, will be a survey of the chemical and physical properties of substances containing silicon as their basic constituent in correlation with their molecular structure.

Studies of human heredity being conducted at the University of Michigan under the sponsorship of **Lee R. Dice** and for the past 7 years supported by annual grants from the Board of Governors of the Horace H. Rackham School of Graduate Studies, will henceforth derive about half of the necessary support from the Laboratory of Vertebrate Biology. The remainder of the support for the work continues for the current year to be provided by a grant from the School of Graduate Studies. Among those engaged in the project are **C. W. Cotterman** (full time); **Harold F. Falls,** Department of Opthalmology, who is cooperating actively; **Sidney L. Halperin,** Neuropsychiatric Institute, who is initiating studies of the heredity of mental deficiency; and **Avery R. Test, Mary Jane Lagler,** and **Byron O. Hughes. James V. Neel** is temporarily on leave for Army service.

The Polytechnic Institute of Brooklyn will offer the degree of Doctor of Philosophy in Applied Mechanics, beginning with the current semester. Thesis subjects for the new degree will be in the fields of theory of elasticity, theory of plasticity, theory of structures, aerodynamics, hydrodynamics, gas dynamics, or the theory of vibrations. Last year the Institute introduced a new curriculum leading to the degree of Master of Science in Applied Mechanics to make available to graduate engineers a broad knowledge of the principles of mechanics which became so important in the new concepts of design developed during the war. These studies were incorporated in the expanded Department of Aeronautical Engineering under the title of the Department of Aeronautical Engineering and Applied Mechanics, headed by R. P. Harrington.

Glenn T. Seaborg, director of chemistry, Radiation Laboratories, University of California, Berkeley, and **Sir Ian Morris Heilbron,** director, Chemical Laboratories, University of London, England, will deliver special lectures at the University of Notre Dame during the current academic year. During the week of November 17 Dr. Seaborg will deliver the 1947 Nieuwland Memorial Lectures in Chemistry, a series established by Notre Dame to honor the memory of the late Rev. Julius A. Nieuwland, C.S.C., who conducted research at the University leading to the discovery of the basic formula for synthetic rubber. Sir Ian will be the first Reilly Lecturer in Chemistry and will visit Notre Dame during April and May, 1948. This lecture series was established by Peter C. Reilly, a member of the Board of Lay Trustees and the Advisory Council for Science and Engineering, Notre Dame.

The University of California, Santa Barbara College, has recently created the Departments of Biological Sciences and Physical Sciences to replace the former Department of Natural Sciences. The new departments were established to facilitate the operation of the expanded science program and give recognition to growing emphasis in the liberal arts field. **Elmer R. Noble,** associate professor of zoology, has been appointed chairman of the Department of Biological Sciences, and **Hazel W. Severy,** formerly head, Department of Natural Sciences, has been appointed chairman of the Department of Physical Sciences.

The University of British Columbia has recently made the following new appointments in the Department of Physics: **Kenneth R. More,** Ohio State University, professor; **John B. Warren,** Department of Natural Philosophy, Glasgow University, associate professor; **George L. Pickard,** Operational Research Section, Royal Air Force, associate professor; **A. Van der Ziel** and **A. J. Dekker,** Phillips Laboratory, Eindhoven, Holland, associate professors; and **G. G. Eichholz,** Leeds University, assistant professor.

Illinois Institute of Technology has undertaken a $34,000 two-year research project in conjunction with the U. S. Navy's continuous fight against corrosion. The new program will be supervised by **Hugh J. McDonald,** director of the Institute's Corrosion Research Laboratory. The problem will be to develop a more rapid and exact method of rating the chemicals which retard corrosion and to devise a numerical scale for expressing their worth.

Oklahoma Baptist University has moved its Biology, Geology, and Physics Departments into the new two-story W.

T. Short Memorial Science Hall, which was named in honor of the University's pioneer professor of mathematics and physical sciences, and completed in August. The removal of these three departments from Shawnee Hall has permitted an expansion of the Departments of Photography and Chemistry.

Cornell University will dedicate Savage Hall, new home of its School of Nutrition, on October 10 at a convocation on "Nutrition—A Key to Human Welfare." Speakers will include Thomas E. Dewey, governor, New York State; Clifford R. Hope, congressman from Kansas, and chairman, Congressional Agriculture Committee; W. H. Sebrell, National Institute of Health, Bethesda, Maryland; Frank M. Smith, chairman, New York State Conference Board of Farm Organizations; Leonard A. Maynard, director, School of Nutrition, Cornell; and Neal D. Becker, chairman, Cornell University Board of Trustees. Savage Hall, built and equipped with the aid of funds provided by New York State and by farmers of the Northeast, will provide the School of Nutrition with greatly enlarged facilities for teaching and research. The building is named for Elmer Seth Savage, professor of animal husbandry, Cornell University, an early leader in nutrition studies and a member of the faculty for 35 years until his death in 1943.

Case Institute of Technology has recently established a Research Laboratory for Mechanical Metallurgy, which occupies the newly constructed third floor of the Rockefeller Metallurgical Engineering Building on the Case campus. **George Sachs,** professor of physical metallurgy, has been appointed director of the new laboratory which will supplement the graduate instructional and research facilities of the Department of Metallurgical Engineering. The modern equipment of the laboratory makes it one of the most complete of its type in the engineering colleges of the country.

The State College of Washington, Pullman, has announced the following new appointments in the Department of Horticulture during the last six months; **Archie Van Doren,** formerly of Ohio State University, as associate professor and associate horticulturist, to investigate fruit handling and storage problems; **Edward Ross,** formerly of the University of California, as associate professor and associate horticulturist, to investigate fruit and vegetable processing; **E. W. Kalin,** formerly of the University of New Hampshire, as assistant professor of floriculture and assistant horticulturist; **J. W. Caddick,** formerly of Cornell University, assistant professor of landscape gardening and assistant horticulturist; and **T. E. Randall,** formerly superintendent of the seed production laboratory, Mount Vernon, Washington, transferred to the State College as associate professor and associate horticulturist, to be concerned with horticultural breeding problems and cytogenetics.

Meetings

At the 92nd convention of the Electrochemical Society, Inc., to be held October 15-18 (*Science*, August 15), J. B. Fisk, director of research, U. S. Atomic Energy Commission, and E. D. Canham, editor, *The Christian Science Monitor*, will be the luncheon speakers. A dinner will be given in honor of Colin G. Fink, who has retired as secretary of the Society after 26 years of service.

Brookhaven National Laboratory will hold a Conference in Biology and Medicine on October 16-18. Subjects for discussion have arisen out of the many questions raised by scientists interested in the use of radioisotopes in medical and biological research. Topics include: "Legal Aspects in the Use of Radioactive Materials," "Protective Measures for Personnel," "Protective Measures for Public Health," "Evaluation of Procedures Used in the Examination of Individuals Exposed to Radioactive Materials," "Procurement of Isotopes," "Shipping of Isotopes," "Handling of Radioactive Materials," and "Disposal of Radioactive Waste Materials." There will also be a demonstration of radiation detection instruments.

Those interested in attending the Conference should communicate with Miss Ellen Matteson, Secretary, Conference Committee, Brookhaven National Laboratory, Upton, New York.

The Surgeon General, U. S. Public Health Service, has appointed an Advisory Board whose function is to designate the proper names for the several anti-Rh blood-typing serums licensed under the Biologics Law. The desire is to have recommended a system of nomenclature which will be adequate to cover this phase of human genetics and which can be readily adapted to clinical use, medical teaching, and laboratory diagnosis. Members of the Board are: William B. Castle, Jr., professor of medicine, Harvard Medical School; Maxwell M. Wintrobe, professor of medicine and department head, School of Medicine, University of Utah; and Laurence H. Snyder, professor of medical genetics and dean of the Graduate School, University of Oklahoma.

At a Conference on Nomenclature of the Rh Factors, to be convened at 9:30 A.M., October 20, at the Hotel Statler, Washington, D. C., and continued through the 21st, the Board will be pleased to hear evidence from persons qualified in this field. Those having evidence to present should communicate in advance with: M. V. Veldee, Chief, Biologics Control Laboratory, National Institute of Health, Bethesda 14, Maryland. Others desiring to attend will be welcome, but advance notice of interest will be appreciated so that meeting accommodations may be assured. Copies of speakers' remarks, if extensive, are desired by the Board.

The American Society for X-Ray and Electron Diffraction and the **Crystallographic Society of America** on July 15 issued an invitation to the Crystallographic Union to hold its first International Congress in the United States late in the summer of 1948. Although no official answer has yet been received from the Union Committee, the response from individuals has been favorable, and plans are being made for the group to be accommodated on a small university campus, probably during the week of August 30-September 5.

Recent Deaths

Alice J. Rockwell, 49, clinical psychologist, University of Maryland Medical School and Hospital, and Maryland Mental Hygiene Society, died September 3.

Robert Nason Nye, 55, associate pathologist, Boston City Hospital, and assistant professor, Harvard Medical School, died September 10 after a brief illness.

William Gillespie, 76, professor emeritus of mathematics, Princeton University, and a member of the Princeton faculty for 42 years before his retirement in

1939, died September 13 at his home in Princeton after a long illness.

Selig Hecht, 55, professor of biophysics, Columbia University, and a well-known authority in the field of vision, died September 18 of a coronary thrombosis at his home in New York City.

The British Association for the Advancement of Science, under the auspices of its Division for Social and International Relations of Science, on May 10 held a conference on "The Place of Universities in the Community." The following resolution, proposed by Sir Henry Dale, president of the Association, and passed unanimously, has since been approved by the Council: "This Conference recommends to the Council of the British Association that they should make representations to the competent authorities of all Universities of the British Commonwealth, urging that no contract should normally be accepted by the Scientific Departments of these Universities, if its terms include any restriction on freedom of publication."

Ludwig Silverberg remains unlocated in Europe. A recent search failed to disclose his whereabouts. Dr. Silverberg left Germany in 1936, and until recently his address has been "The Hague, Netherlands." Since further information is desired concerning some of his inventions, any assistance which can be given in locating Dr. Silverberg would be greatly appreciated. Communications should be addressed to: Reed Research, Inc., 1048 Potomac Street, N.W., Washington 7, D. C.

Make Plans for—

American Public Health Association, October 6–10, Atlantic City, New Jersey.

American Association of Cereal Chemists, New York Section, October 7, 2 Park Avenue, New York City.

American Academy of Ophthalmology and Otolaryngology, October 12–17, Chicago.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS
by Readers

This communication is written in the hope of opening a constructive discussion of the editing of scientific papers. That the subject deserves airing is certain from the continued grumbling we all hear and often swell. As editor of several journals and contributor to many more, I have both sinned and been sinned against. At the moment, several adventures in publication have put me more on the sinned against side, which prompts this note. It will be restricted to the problem of form; content is an independent subject.

Every journal is entitled to insist on certain style uniformities. If a certain spelling of a word (fiber rather than fibre) is preferred, if particular abbreviations are used or rejected (hr. for hour, but not % for percent), if a particular form of literature citation is demanded, the author who objects should submit his paper elsewhere. Good sense should prevent an unyielding application even of such rules —"Hrs. later conduction failed," or even, "After hrs. . . .," would hardly do; but the editor is arbiter of usage. Further, no author will complain about correction of errors in spelling, punctuation, grammar, citation, fact (providing they *are* errors); and few, about *suggestions* of improved sentence structure, or organization, or even the nuances of style. But here the pendulum swings over, and the author, not the editor, has become final arbiter. The editor may only suggest.

An editor may properly reject a paper solely on the basis of obscure or verbose presentation, or may offer to accept it subject to improvement, or may generously detail the revisions demanded for acceptability and others recommended for improvement of the presentation. The decision is then the author's: to submit his paper elsewhere, to sweat over it further (perhaps with the aid of a more literate colleague), or to welcome the editor's proffered help and accept those revisions which seem good to him. There is one absolute essential in editor-author relations that I am saving for the "punch line"; with that operative, the balance indicated can work admirably.

I know editors who have performed minor and major surgery on hundreds of manuscripts; who have, in special cases, as when highly important results were poorly presented, literally rewritten an article completely. (One condensed, by rewriting, a 75-page manuscript, by a man senior in age and achievement, into one of 23 pages.) And no anguished cries resulted. On the contrary, it was generally true that the more drastic the operation, the more grateful the subject. The reason? Adherence to the critical condition.

I know authors who have been awed to find an incorrect page number in an obscure reference questioned by the editorial office; who have been delighted to have headings of comparable tables recast into comparable form, and pleased to note correction of misspellings or of infelicitous constructions; who have been sadly tolerant, mostly, when commas have been deleted or adjectives substituted (for some sprinkle their commas and choose their words with considerable care, and the results are as intended); and who have been, sometimes, extremely annoyed when sentences have been recast, material omitted, style altered, meaning changed. Why annoyed? Because the critical condition was *not* always adhered to.

The editor should have final say as to what appears in his journal. The author should have final say as to what appears under his name. Between reasonable men agreement is readily attained, when adequate opportunity exists for exchange of reasons and preferences. In a case I know of, an invited article in a symposium on a highly controversial issue, the editor made many and serious changes from the original manuscript. The author restored the original form in galley proof and wrote a full explanation of his wish to retain his presentation. This letter was not acknowledged and some of the objectionable editorial changes remained in the published article.

By all means, have the editor "vet" each manuscript. Let him alter it to the best of his ability and his available time. Let him indicate which changes are demanded if the article is to be accepted, which are judged highly desirable, which are minor suggestions. (All this is also applicable to content of an article, although this is less often altered.) And then, if any question of the acceptability of the changes to the author be possible, *insist that the edited manuscript, not proof, be returned early to the author for his consideration.* (R. W. Gerard, *Department of Physiology, University of Chicago.*)

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By the regulated action of sulfuric acid paper is converted into vegetable parchment. Under similar conditions (occasionally in the presence of formaldehyde), cotton is transformed into a variety of Heberlein fabrics. Such treatment of other cellulose fibers, e.g. esparto, flax, jute, sisal, plywood (prior to folding), etc., would lead to a wide range of new materials possessing useful and attractive properties. Increased tensile strength, waterproofing, and general durability should add to the value of thread and plywood and result in a further development of textile and constructional material. In the case of wood, owing to its lignified condition, some preliminary treatment may be necessary, although not so drastic as that employed in the purification of wood pulp. The single fine layers of plywood should respond readily to such processing without impairing its original mechanical structure. (Maurice Copisarow, *1 Gildridge Road, Manchester, England.*)

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Recent reports on the results of glucose tolerance tests in vitamin-deficient animals (O. H. Gaebler and W. E. Ciszewski. *Endocrinol.*, 1945, **36**, 227; A. Chesler, E. Homburger, and H. E. Himwich. *J. biol. Chem.*, 1944, **153**, 219; S. Banerjee and N. C. Ghosh. *J. biol. Chem.*, 1947, **168**, 207) do not refer to a series of papers published by McCay (D. McCay, *et al. Indian J. med. Res.*, 1916, **4**, 1–27; 1918–19, **6**, 485–549; 1919–20, **7**, 22–80, 81–147). I came across McCay's papers fortuitously, and it seems probable that the later authors were not aware of the vast amount of work that had been done on human subjects at an earlier date. Nor have I been able to find any reference to these studies in books, reviews, or textbooks that might be expected to mention the work. Since the studies were carried out with large numbers of patients and occupy several hundred pages of journal space, with many fully charted case reports, it is obviously desirable that they be called to the attention of modern nutritionists and physiologists.

McCay reported many cases in which patients who were losing *50 to 150 grams of glucose* daily in their urine were made aglycosuric within 2 or 3 days. The patients were first restricted to a diet of milk, vegetables, and butter for a few days: "One to two pints of milk, 12–16 oz. of green vegetables, and 2 oz. of butter for 3 days will clear the urine of sugar and the blood of hyperglycemia in 99 per cent of all cases" (*Indian J. med. Res.*, 1919–20, **7**, 81–147). The diet was then slowly built up until the caloric content was adequate, and eventually the patients were allowed to increase the rice in the diet. However, it was also stated that "in the treatment of diabetes in India the value of green vegetables cannot be too highly appraised."

One might surmise that the patients McCay studied were deficient in one or more vitamins. Certainly his findings should be confirmed or denied in terms of modern nutritional knowledge. If any assessment has, in fact, been made, no doubt others would like to hear of it. (Van R. Potter, *University of Wisconsin Medical School.*)

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Egg number is a matter of interest in fishery biology, especially through its relation to mortality rates. The maximum usual number of ripe eggs in an individual of *Ostrea virginica*, estimated at 50,000,000–60,000,000 by W. K. Brooks (*Rep. Comm. Fish. Md.*, 1880, p. 14) and T. C. Nelson (*Bull. N. J. agric. exp. Sta.*, 1921, **351**, 8), has more recently been placed at 500,000,000 by P. S. Galtsoff (*Science*, 1930, **72**, 97–98). Computation of the volume represented by various numbers of eggs suggests that the order of magnitude of the later estimate may be too high.

Galtsoff's value was based on an estimate of 115,000,000 eggs discharged at a single spawning. The gonad of this medium-sized individual was still 7 mm. thick after this discharge and was considered to contain sufficient ripe ova for the spawning season's estimated four or five further periods of oviposition. However, 115,000,000 eggs 0.05 mm. in diameter (W. R. Coe. *Biol. Bull.*, 1932 **63**, 428) would amount to a solid mass of about 8 cc. and would presumably require an ovary of about double this volume. From the data of C. Grave (*Rep. Shellfish Comm. Md.*, 1912, **4**, 42) on cubic content of oysters, it would appear that Galtsoff's individual probably had a total body-volume of only about 15 cc. Therefore, it seems likely that the number of eggs discharged was miscalculated, perhaps by misplacing a decimal point.

A layer of gonad 7 mm. thick would be unusually great, since V. L. Loosanoff and J. B. Engle (*Bull. U. S. Bur. Fish.*, 1937, **33**, 230) report a maximal average thickness of 9 mm. for any 6-oyster sample on any date and an average of only 4 mm. for 19 samples on the best date. The volume of a gonad 7 mm. thick in an oyster 3.7 inches long seems unlikely to have been as much as 10 cc., and the volume of packed eggs which it could have accommodated would probably not be as much as 5 cc. Therefore, if (as he evidently believed) Galtsoff's oyster had discharged only about one-fifth of its ripe eggs, the absolute quantity discharged might well have been only 0.8 cc., or 11,500,000, instead of 115,000,000.

The solid volume of a half billion eggs would be about 2 cubic inches. About 110 such masses would fill a gallon. Allowing for looser packing in the ovary and for the nonovarian content of the animal, it seems probable that an oyster of size to contain 500,000,000 eggs would be one of some 40/gallon at smallest. The largest recognized commercial category of oyster ("extra large") is defined at 160/gallon. Galtsoff's oyster was evidently a "select" of about 270 count.

It is, of course, possible that, by continued gametogenesis after the inception of spawning, an oyster might during a single season produce eggs in excess of its own volume. However, available reports do not make clear to what extent this might occur in *Ostrea virginica*, and this possibility was evidently not the basis of Galtsoff's estimate. (Martin D. Burkenroad, *Survey of Marine Fisheries of North Carolina.*)

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TECHNICAL PAPERS

Citrinin as an Antibiotic

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This is a preliminary report on bacteriologic, toxicologic, and therapeutic studies on citrinin begun by two of us in the Pincomb Chemical Research Laboratories in the early spring of 1945 and participated in by the group in The National Institute of Biological and Chemical Production beginning in 1947. The citrinin used in these experiments was isolated from the culture medium of *Penicillium citrinum* Thom, identified by G. Smith in England through the courtesy of J. Needham and found to be identical to that of Hetherington and Raistrick (*2*).

The study on bacteriostatic properties of citrinin was begun before V-E Day in complete ignorance of the work of Raistrick and Smith (*4*), Robinson (*5*), Oxford (*3*), and Ambrose and DeEds (*1*). The details of all these reports on antibiotic properties, with the exception of that appearing in the *Journal of Pharmacology,* are still not accessible to the authors. Table 1 summarizes the results from our inhibition experiments with citrinin on bacterial growth.

TABLE 1

Species of bacteria	Gram stain	Minimum concentration of citrinin (mg./cc.)	Results
Str. viridans	+	0.05	Complete inhibition
B. mycoides	+	0.05–0.1	" "
B. graveolens	+	0.1	" "
Staph. aureus	+	0.4	" "
Pneumococcus	+	0.5	" "
V. cholerae	–	1	" "
B. typhosus	–	1	" "
B. dysenteriae Flexner	–	2–4	" "
B. coli	–	4	" "
B. paratyphosus	–	8	" "
Ps. pyocyanea	–	>15	Partial "

For inhibition tests, 1 drop of a 24-hour bacterial culture was added to 1 cc. of ordinary broth medium containing different amounts of citrinin. After incubation for 16 hours, readings were taken. The figures in the third column represent the minimum concentrations of citrinin required for the complete inhibition of growth of different species of bacteria within 16 hours of incubation. It is evident that gram-positive bacteria are more susceptible to citrinin than gram-negative ones. *Streptococcus* and *Bacillus mycoides* are the most susceptible.

It is interesting to note that bacteria could be "sensitized" by citrinin so that their resistance was significantly reduced by continuous subcultivations in media containing subminimal concentrations of citrinin. For instance, untreated *Staphylococcus aureus* required 0.4 mg./cc. of citrinin for complete inhibition, but after 10 treatments with citrinin (2 × 0.1 mg., 8 × 0.05 mg./cc.) it required only 0.05 mg., the time interval between two subsequent treatments being always 24 hours. The bacteria so treated resumed their normal multiplications immediately after being transferred into an ordinary broth medium. After 9 transfers in the broth, the descendants were still sensitive to citrinin, since 0.1 mg. of citrinin was already sufficient for their complete inhibition. Another instance is *Pseudomonas pyocyanea.* This could be inhibited by 4 mg. of citrinin after 9 subsequent subcultivations in a 0.4 per cent citrinin-broth medium, which was normally ineffective. The other bacteria (*Str. viridans, B. typhosus, B. dysenteriae, B. coli, B. paratyphosus,* and *B. mycoides*) behaved similarly.

Another remarkable finding was that the citrinin-treated staphylococci were also more susceptible to sulfadiazine. For example, those which were untreated required more than 5 mg. of sulfadiazine/cc. of medium for inhibition, while the "sensitized" ones needed 1 mg./cc. only.

Human serum (10 per cent) had no significant effect on the action of citrinin on *Staphylococcus, B. typhosus,* and *B. mycoides.* Cysteine (0.25 per cent) had no counteraction on citrinin. Sodium thiosulfate (0.5 per cent) and p-aminobenzoic acid (0.1 per cent) had no antagonistic action.

For toxicity tests we used albino rats and rabbits as experimental animals. For the rat the intraperitoneal lethal dose of citrinin was 1.7 mg./100 grams body weight, and for the rabbit, 5. mg. Autopsy showed hemorrhages in lungs and liver and accumulation of blood in the chest cavity. Repeated daily injections of citrinin in increasing doses resulted in increasing the tolerance of the animal to this substance. One rat (350 grams) was still living after receiving a total amount of about 155 mg. in 27 injections (1 × 0.8, 5 × 2.8, 8 × 4, 5 × 6, 4 × 8, and 4 × 12 mg.). A single intravenous injection of citrinin (2 mg./100 grams body weight) into the rabbit caused lacrimation, nasal discharge, salivation, drowsiness, and lowering of body temperature.

For therapeutic tests we have tried local application of citrinin on rabbits and human beings, and the results seemed very encouraging. In one experiment four rabbits of about 2 kg. were used. A piece of skin (1 × 3 cm.), together with some muscle beneath, was excised and the wound inoculated with *Staph. aureus.* After extensive pus formation two of the animals were treated locally with citrinin powder, one with sulfadiazine powder, the fourth, without any treatment, serving as a control. The citrinin-treated animals responded excellently. On the following day the lesions dried up, crusts formed, and in two days the wounds had healed. The sulfadiazine-treated rabbit showed some improvement, although some pus was still present on the fourth day of treatment. The control showed no improvement at all within 7 days.

Clinically, citrinin has been used in three cases of local infections, all of which showed dramatic results. The first had a cheek carbuncle with an indurated base inches in diameter; the second, an infected wound in the right palm; and the third, an ulceration with marked redness and induration over the chin and with enlarged and tender submaxillary lymph glands. The first two were staphylococcal infections; the last, streptococcal. Citrinin-sodium bicarbonate powder was applied locally to the infected region, and the indurated base was infiltrated with sodium-citrinin solution (1 per cent), after which it was dressed with citrinin-soaked gauze. At first, all experienced some needling pain but no other discomfort. The infected area dried up in 6-18 hours, the crust formation being followed by rapid healing.

The study on citrinin is still being carried on in the Pincomb Chemical Works along chemical, bacteriological, and clinical lines. The details of the above experiments will be published elsewhere.

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Lactobacillus acidophilus Counts in the Saliva of Children Drinking Artificially Fluorinated and Fluorine-free Communal Waters[1]

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It has been demonstrated that there is a direct correlation between the number of *L. acidophilus* organisms in the saliva and dental caries activity in the mouth (*3*). In mouths with active dental decay the number of bacteria per cubic centimeter of saliva is high (20,000 or more), and in mouths in which the teeth are immune to decay at any specific time the counts are negative (under 100). Studies conducted by Jay (*5*) among representative population groups reveal that approximately 15 per cent of the individuals sampled have negative counts and about 57 per cent significantly high counts.

It has been established by Dean, *et al.* (*4*) that in areas in which fluorine occurs naturally in the drinking water supply there is a lower-than-expected incidence of dental decay among the group of the population studied (12- to 14-year-olds). In these fluoride areas, there is a much-greater-than-expected proportion of negative *Lactobacillus* counts (37.4 per cent) and a smaller-than-expected proportion of high counts (27.5 per cent) when the drinking water contains more than 1 ppm fluorine. The results of these *Lactobacillus* studies tend to confirm the dental findings.

The purpose of this paper is to present a preliminary observation made in connection with the studies of *L. acidophilus* counts in the Newburgh-Kingston Fluorine Demonstration, now being conducted by the New York State Department of Health (*1*, *2*).

In order to determine the efficacy of introducing fluorine artificially into a public water supply for the purpose of reducing the incidence of dental caries, 1 ppm fluorine as sodium fluoride has been incorporated into the Newburgh water supply continuously since May 1945. Kingston, a comparable city, is consuming fluorine-free water and is being used for control purposes.

In Newburgh, individual *Lactobacillus* counts were made on random samples of the school population in 1944 and again in 1946 and 1947. The Kingston school population was sampled in 1946 and 1947. The findings are depicted in Fig. 1.

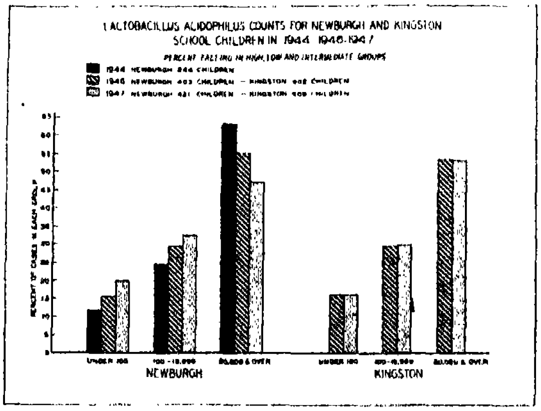

FIG. 1. *Lactobacillus acidophilus* counts for Newburgh and Kingston school children 1944–1946–1947—per cent falling in high, low, and intermediate groups.

Samples of saliva collected from 244 children of school age in Newburgh late in 1944 (prior to the introduction of fluorine into the municipal water supply), showed that 11.9 per cent were negative, and 63.5 per cent had counts of 20,000 or over. Analyses of salivas of 403 children in the same community early in 1946 revealed that there were 15.4 per cent negative counts and 55.2 per cent high counts. Of 421 samples collected early in 1947, 20 per cent had negative counts, while 47.3 per cent had high counts. In contrast, an analysis of the salivas of 402 children in Kingston early in 1946 revealed that 16.2 per cent had negative counts and 54.2 per cent, counts of 20,000 or over. In early 1947, among 408 children in Kingston, 16.2 per cent had negative counts and 53.9 per cent, counts of 20,000 or over.

It will be observed that while in Kingston the percentages of high and low counts remained approximately constant for the two-year period, there has been a consistent drop in percentages of high counts and a rise in the percentages of low counts in Newburgh since fluorination of the municipal water supply.

The standard significance tests were applied to the differences between the 1944 and the 1947 figures. The rise in the percentage of low counts (8.1 per cent) was 2.68 times its standard error, with a chance probability of .007. The drop in the percentage of high counts (16.2 per cent) was 4.03 times its standard error, with a chance probability of .00006. These differences may be considered statistically significant.

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[1] The media were furnished by the Division of Laboratories and Research, New York State Department of Health.

The authors wish to acknowledge the assistance of Mrs. Adele Polansky, statistician, and Miss Marion Guernsey, laboratory technician.

Although this is only a preliminary observation, it is in the direction which would be expected if artificial fluorination ultimately produces a decrease in dental caries.

Klein (*6, 7*) has recently shown, in higher fluorine concentrations, that a reduction in dental caries from fluorine can be a posteruptive phenomenon. Since all the children examined in Newburgh drank water containing fluorine after many of their teeth had already erupted, the *Lactobacillus* counts bear on the controversial question of the effect of fluorine after eruption of the teeth.

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A New Antibody in Serum of Patients With Acquired Hemolytic Anemia

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It has been possible to demonstrate an incomplete or "blocking" type of antibody in the sera from three patients (A. G., S. N., and L. H.) with acquired hemolytic anemia. None of these showed autoagglutination; one possibly showed autohemolysis. No significant titers of cold agglutinins were found. Donath-Landsteiner and Ham tests were negative. All had had splenectomy. One (S. N.) died; the other two have made some clinical and hematological improvement. Serum obtained prior to splenectomy was studied in one instance (A. G.).

TABLE 1

Idiopathic Acquired Hemolytic Anemias

Test	Patients		
	A. G.	L. H.	S. N.
Autoagglutination	−	−	−
Panagglutination	−	−	−
Autohemolysis	−	−	+
Direct developing test	++++	+++	++
Pos. indirect developing tests	12	7	3
No. of indirect developing tests performed*	12	7	3
Titer of free antibody	1/4,096	1/256	1/128

*Each test performed with type O cells from different individuals, both Rh− and Rh+.

Serum from rabbits immunized with human serum has been used to demonstrate the presence of the incomplete antibodies, both on the red cells and free in the sera of the patients. It has also been possible to trace the antibodies through several procedures which demonstrate some of their immunological properties. The testing (developing) serum prepared in a manner similar to that described by Coombs, Mourant, and Race, gave a positive interphase precipitin test against human serum diluted 1/20,000 (*2*). A "direct developing test" is performed against thoroughly washed patient's cells. If the cells agglutinate on addition of the developing serum, the test is considered positive. The "indirect" test is performed in the same manner against appropriate normal cells which have first been incubated with the patient's serum. If agglutination occurs, it is presumed to constitute a demonstration of free antibody in the patient's serum (*1, 3*). A titration of the free antibody in the patient's serum can be made, using the indirect method, against cells sensitized in serial dilutions of that patient's serum. The actual developing test is done by the slide technique. Equal volumes of a 2 per cent sensitized cell suspension and the developing serum are mixed on a slide and allowed to stand for 5 minutes. Table 1 summarizes results common to all three patients. Table 2 lists comparable observations on control cases of hemolytic anemia.

TABLE 2

Control Hemolytic Anemias

	Hereditary forms			Erythroblastosis fetalis	
	Cooley's (2 cases)	Familial jaundice (2 cases)	Sicklemia (1 case)	Patient (3 cases)	Mother (3 cases)
Auto- and panagglutination	−	−	−	+−	−
Auto- and panhemolysis	−	−	−	−	−
Direct developing test	−	−	−	++	−
Titer of free antibody					
Rh+ cells				1/32	1/512
Rh− cells				0	0

Further studies have been carried out with serum from case A. G. The titer of antibody in the presplenectomy serum was found to be 1/512, this serum having been stored at 4°C. for 6 months. The postsplenectomy titer is 1/4,096 in fresh serum. It has been possible to test the thermolability and species specificity and to investigate the relative position of the receptor for this new type of incomplete antibody. A high-titer saline eluate (1/512 at 56°C., 1/32 at 37°C.) of the antibody from A. G. was prepared by incubating patient's cells or sensitized normal cells in equal volumes of saline for ½ hour at 56° or 37°C. Table 3 lists the reactions of this eluate with various receptors as brought out by the developing test.

TABLE 3

Reaction of the A. G. Antibody With Various Receptors

Receptor	Developing test
Type O cells	
Rh+	++
Rh−	++
Type B cells	++
" AB cells	++
" A cells	++
Rhesus cells	0*
Sheep cells	0†

* Developing serum first absorbed with "unsensitized" rhesus cells.

† Sheep cells sensitized with human heterophile antibody have been found to give a positive developing test.

Other observations of the A. G. serum have shown that the antibody cannot be demonstrated by the developing test to have reacted with red cells stored in normal saline solution for several days. Type A, B, and AB cells, strongly sensitized in a saline eluate, react in the usual manner with α and β isoagglutinins as specifically and intensely as prior to their being sensitized. Rh+ cells similarly sensitized likewise are not affected in the reactivity with Rh agglutinins. This is interpreted as showing that the A. G. antibody does not block the Rh and major blood-group receptors. This antibody is not reduced in potency at exposure to 70°C. for 10 minutes, but cannot be demonstrated by the indirect developing test after exposure of the serum to 80°C. for 10 minutes. As shown in the above tables, (in distinction to the Rh antibody) this antibody reacts with red cells irrespective of Rh type, is also an autoantibody and a panantibody, but does not react with rhesus cells.

Hematological, histological, and clinical data, as well as further immunological studies concerning these three patients will be submitted in greater detail in a future publication.

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Further Observations on Leptospirosis in Micronesia

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Murine leptospirosis has given rise to a public health problem in many parts of the world (*2*) because the etiologic agent, *Leptospira icterohemorrhagiae*, also causes Weil's disease in man. Since the United States now has control of many islands in the Pacific, it seemed advisable to start work of a survey nature on these islands to find out whether leptospirosis constitutes a menace to the native peoples and our own personnel. Such investigation was started during the summer of 1946, when the University of Hawaii, in cooperation with the Navy, sent a number of biologists into the field.

In a recent report by Alicata (*1*), covering a part of the first summer's work, it was pointed out that 5 out of 40 rats trapped on Moen and Ponape, in the eastern Carolines, were infected with leptospirae. It is the purpose of this communication to note survey findings on the island of Yap, in the western Carolines. Yap, it will be remembered, lies south and west of Guam, about 9 degrees north of the equator. Prior to World War II it was one of the territories mandated to Japan.

A number of traps were put out near the site of the military government unit at Yap Town. The 28 rats which were taken alive were members of 3 species, *Rattus alexandrinus*, *R. norvegicus*, and a third, tentatively identified by Harvey Fisher, of the University of Hawaii, as *R. exulans micronesiensis*. Each animal was killed by drowning the morning after being caught, and a piece of kidney was removed at autopsy immediately after death. The tissue was preserved in 10 per cent formalin for several months before being sectioned and stained by a modification of the Warthin-Starry silver precipitation technic.

Careful microscopic examination of several sections from each rat kidney failed to reveal any spirochetes in the urinary tubules or elsewhere. Although the number of animals is small, it would seem that murine leptospirosis is not present in the area studied. It may be that the geographic isolation of Yap and its lack of shipping facilities have prevented the introduction of *L. icterohemorrhagiae*. Once introduced into this region, which offers much rain and a large rat population, the organism might gain a foothold quickly.

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Triphenyltetrazolium Chloride as a Dye for Vital Tissues

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The use of triphenyltetrazolium chloride as a test reagent for seed germinability was brought to the attention of one of us (R. A. D.) while on a tour of duty in Germany in 1945 as scientific consultant for the Technical Industrial Intelligence Branch of the Joint Intelligence Objectives Agency. The use of this compound for predicting seed germination was based on its ability to stain only those parts of seed embryos which were capable of growth. This fact suggested that the tetrazolium salt might have a wider application as a test reagent for the vitality of tissues other than seeds.

Tetrazolium salts, including 2,3,5-triphenyltetrazolium chloride, were first prepared by Pechman and Runge (*5*) in 1894. In 1941 Kuhn and Jerchel (*2*) synthesized a number of tetrazolium salts by an improved procedure and called attention to the fact that dilute solutions of 5-methyl- and 5-hendecyl-2,3-diphenyl salts stained yeast, garden cress, and bacteria (*3*). These workers believed that the reduction of the colorless salt solutions to a red compound which dyed the plant tissues was not due to the presence of glutathione, ascorbic acid, or cysteine, for the latter substances did not reduce these salts below a pH of 9.0, whereas the characteristic reductions observed on yeast, garden cress, and bacteria took place in neutral solutions.

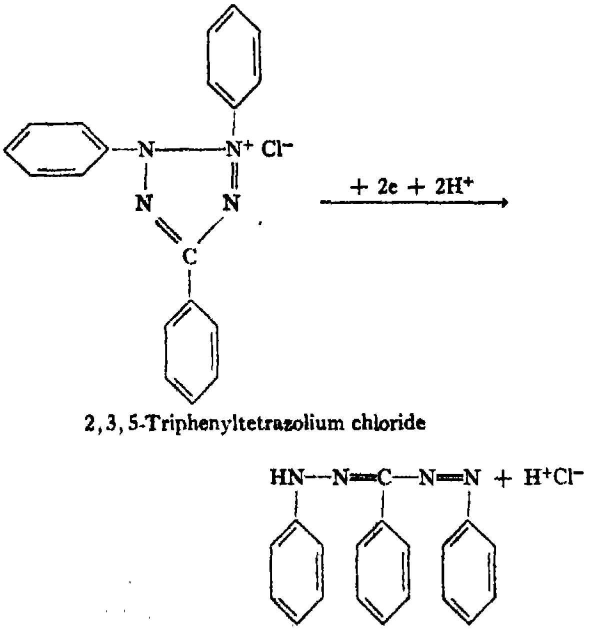
As a result of these studies Lakon (*4*) substituted triphenyltetrazolium chloride for the toxic sodium selenite in his "topographic method" for testing the germinating ability of seeds. By a comprehensive series of comparative staining and germination tests he was able to show that it is possible to predict the germinability of corn, oats, rye, wheat, and barley by observing the embryo parts which are stained by the red, insoluble formazan deposited in viable tissues. The unstained portions of the embryo were shown to be incapable of growth.

Porter, Durrell, and Romm (*6*) used Lakon's tetrazolium method and found a close agreement between the percentage of stained embryos and the percentage of normal sprouts obtained in standard germination tests with corn, wheat, rice, buckwheat, popcorn, soybeans, and Bahia grass. Less satisfactory agreement was found in a comparison of the two methods when applied to vetch and sorgo and to some lots of oats, peas, and barley.

Since tetrazolium salts were not available in this country, we synthesized the triphenyl compound and the 5-furfuryl-2,3-diphenyl derivative and have used these compounds in preliminary studies on various types of viable and nonviable tissues. The furfuryl derivative appeared to give the same tests as the triphenyl compound. In order to prepare tetrazolium salts of suitable purity in satisfactory yields, it was necessary to make certain modifications in the method of Kuhn and Jerchel. This phase of our work will be published later.

Our work also confirms the work of Lakon with seed corn and the observations of Kuhn and Jerchel with yeast. However, we have been interested in the potentialities of the tetrazolium salt as a test reagent for living tissues in general. We have found that many other viable materials, in addition to seeds and yeast, will reduce the triphenyltetrazolium chloride at pH 6.9: the fleshy parts of apples, oranges, and grapes; the gill area of mushrooms; carrot roots, white and sweet potatoes; young leaves; the stigmas and ovaries of certain pollinated flowers; bull sperm and the blastoderm of hen's eggs. Much to our surprise, the serum of bull sperm and the chalazae of egg white give a positive reaction. The reduction of the tetrazolium salt is not due to sugars, for subsequent work has shown that reducing sugars form the red formazan only above pH 11.0, whereas the above-mentioned materials will reduce the triphenyl compound at acidities below pH 7.0.

The use of the tetrazolium reagent should have a distinct advantage over many indicators as a viability test, since it is one of the comparatively few organic compounds which is colored in the reduced state. In the presence of viable tissue the colorless solution of triphenyltetrazolium chloride forms the insoluble red triphenyl formazan by the following reaction:



2,3,5-Triphenyltetrazolium chloride

Triphenyl formazan

It is quite evident that enzyme systems are responsible when this reduction takes place in plant and animal materials, since tissues heated at 82° C. or higher lose their ability to reduce this salt. Furthermore, it is probable that this reduction is caused by dehydrogenase systems requiring coenzymes I or II, for Jerchel and Möhle (*1*) have shown that the apparent redox potential of 2,3,5-triphenyltetrazolium chloride is about −0.08 volt. Thus, it is possible for this compound to act as an electron acceptor for many pyridine nucleotide dehydrogenases. We have found that one of these holoenzymes, glucose dehydrogenase-coenzyme I, in the presence of its substrate, reduces the salt at pH 6.6.[1] Work is being continued to determine if other enzyme systems possess similar properties when treated with this reagent.

Preliminary experiments have indicated that the enzyme systems responsible for the reduction of the tetrazolium salts are present in a wide variety of living tissues. In all probability, the reduction of these compounds by enzymes of living cells cannot be considered a general test for life. Nevertheless, the unusual properties of these reagents suggest that they might be utilized in many types of biological research involving differences in tissue viability.

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Oxygen and Air Pressure Effects Upon the Early Development of the Frog's Egg

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The following constitutes a report on a part of the author's studies of the effects upon early embryological development of (1) different pressures of normal air and (2) various proportions of the constituent substances of normal air under pressure.

Eggs of three species of frogs (*Rana pipiens*, *R. sylvatica*, and *R. palustris*) were used in these observations. Two sets were employed: normal eggs deposited under natural conditions and, in the case of *R. pipiens*, pituitary-stimulated eggs from females brought in shortly before the breeding season and kept in a state of prolonged hibernation in a cold room at approximately 1° C. In the case of eggs deposited under natural conditions, the period of development during which experiment was initiated varied between the 4- and the 16-cell condition. The pituitary-induced eggs were placed in the pressure chambers 15–20 minutes after the sperm suspension was added. Eggs from two separate females and sperm from two males were used in each experiment.

Pressures up to 3 atm. of oxygen were added to the normal air pressure in the pressure chambers. Small egg masses were placed in small glass dishes and covered with water to a depth ranging from ⅛ to ⅜ inch above the surface of the mass. The water remained unchanged while the eggs were in the pressure chambers. Control eggs were kept in finger bowls or crystallizing dishes in shallow water which was changed daily. The control embryos were watched until they reached the late yolk plug and early neuralation state, after which the pressure chambers were opened. The experiments were carried out at room temperature which ranged from 14° to 20° C., with the exception of two experiments on the induced eggs, where the temperature varied between 16° and 25° C.

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[1] We are indebted to F. A. Baldauski, who made the glucose dehydrogenase and coenzyme I preparations.

The following results were obtained for naturally deposited eggs:

(1) Pressures of oxygen added as above have no apparent gross morphological effect upon development through the blastular stage.

(2) Increased pressures of added oxygen have an accelerative effect upon gastrulative and neuralative processes.

(3) Embryos subjected to treatment as above, removed from the chambers, and placed in finger bowls of shallow fresh water continued to develop as follows: (a) Up to 1½–2 atm. of added oxygen no apparent deleterious effects were observed in the tadpole condition. They may show acceleration in development compared with controls; (b) embryos experiencing 3 atm. of added oxygen develop various conditions of abnormal development in the tadpole stage.

(4) Compared with the controls, oxygen added under pressure approximating 1–1½ atm. appears beneficial to early frog development.

Comparison of development of pituitary-induced eggs of *R. pipiens* with that in normally deposited and normally ovulated eggs is under investigation. Thus far the results of experiments with eggs induced during the postbreeding season indicate a greater sensitivity to oxygen administered as above. The following general statements may be made:

(1) Pressures approximating 1 atm. of oxygen added to the normal air in the chamber accelerate development.

(2) Similar pressures produce a recovery effect in some of these pituitary-induced eggs. Comparison with controls demonstrates a greater number of normal-appearing neural fold conditions, with subsequent development into vigorous tadpoles in the oxygen-treated group.

(3) Pressures of added oxygen of 3 atm. suppress development at an advanced blastular condition. A few of these embryos may make abortive gastrulation attempts.

Red Blood Cell Sensitivity to the Blood-Group-Enzyme

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The blood-group-enzyme, termed BGE, was first described by Schiff and co-workers (*4*), who considered it a physiological component of certain human secretions and excretions, being notably present in saliva and normal feces. The designation was adopted because these investigators found that the enzyme, independently of its source from an A, B, or O individual, acted on the blood group antigens of all the blood groups by destroying them. More recently, Schiff and Boyd (*3*) proposed the more inclusive designation "blood-group-property-destroying-factor."

Significant in relation to the present report is the statement by Schiff and Akune (*2*) that this enzyme was not found in the brain or the blood serum.

The method of production of the BGE by the early workers consisted in inoculating a nutrient broth either with a saline extraction of normal nondiarrheal feces or with saliva (Sievers, *5*) and then incubating the broth at 37° C. for 24 hours. By this procedure, the enzyme, which in the natural state is attached to either cellular debris or certain anaerobic bacteria, becomes enriched.

There was no evidence that BGE played any role in human pathology until 1941, when Neuda, in work done at the Pneumonia Laboratory of the Harlem Hospital, New York City, showed that the red cells of negroes suffering from sickle-cell disease developed sickle cells in from 10 to 30 minutes (at times much more rapidly) when suspended in a fluid medium prepared by the Schiff method and presumably containing the BGE. The preparation of the test fluid and the test itself were described by Neuda and Rosen (*1*) in 1945. In this paper, reasons were enumerated which suggest that Schiff's blood-group-enzyme might be identical with, or closely similar to, the sickle-accelerating substance. Whether or not this assumption is correct can be established only by future investigation. At the present stage of the work, however, this preliminary assumption seems appropriate as a working hypothesis. There are already further evidences at hand which point in the same direction. There remains the outstanding fact that a fluid produced by the Schiff method will rapidly reveal the presence or absence of the sickling quality if red blood cells obtained from a negro are suspended in this fluid.

Observations made since the previous paper appeared, which will be published shortly, have demonstrated that the sensitivity of human red cells to the BGE is not restricted to sickling negro cells. Essentially similar intermediate changes as were found to precede the final sickle-cell configuration in the red blood cells of negroes were found to occur also in red cells derived from Caucasians. The final twisted cell silhouette, however, remained a characteristic of the negro red cell.

This observation led to the conclusion that the possible damage to the red cells by this enzyme fluid might be more widespread than in sickle-cell disease alone. We have therefore coined the phrase "hemolysis of sickle-cell type" to signify this peculiar kind of blood destruction, and the expression "red cell sensitivity to the blood-group-enzyme" to indicate the liability of any red cell to react in characteristic fashion to the substance produced by the Schiff method.

The Schiff method has the disadvantage of using a material which is greatly contaminated by bacteria, so that the resultant changes in the red cells could be attributed to bacterial action. Schiff and Akune, however, have disproven this possibility regarding the BGE action by demonstrating that rigid filtration with removal of the bacteria weakened, but did not completely abolish, the action of the BGE.

A first attempt was therefore made to apply the Schiff method of enrichment by culture to plasma (or serum) of a sickle-cell case. This was done by pipetting about 2 cc. of sterile plasma (or serum) into 25 cc. of sterile nutrient broth, the mixture being corked and incubated at 37° C. for 24 hours.

This plasma(serum)-broth mixture developed the same sickle-accelerating substance as was originally produced from feces. The same procedure was successful in four more cases suffering from the following diseases: hemolytic jaundice, ulcerative colitis, pernicious anemia, and cancer of the breast (postoperative).

The observations were carried further, and it was found that occasionally fresh plasma of certain individuals would produce the sickling effect on red cells directly, without the process of enrichment by culture. This was observed in two cases of cirrhosis of the liver, two cases of toxemia of pregnancy, and one case of myelogenous leukemia.

TABLE 1

Schiff's enzyme	Diagnosis of cases	No.
In plasma (serum)-broth	Sickle-cell disease	1
	Hemolytic jaundice	1
	Ulcerative colitis	1
	Pernicious anemia	1
	Cancer of the breast	1
In natural plasma	Cirrhosis of the liver	2
	Toxemia of pregnancy	2
	Myelogenous leukemia	1
Total..		10

A total of 10 cases have revealed, by two different methods, the presence of the sickle-accelerating substance in blood plasma, a substance which, using Schiff's method, was found originally only in feces and saliva (Table 1).

It appears therefore, that the sickle hemolysis-inducing substance, presumably BGE, or a substance closely related to it, is occasionally present in human blood under conditions still to be studied, and that it exists in two forms (demonstrable by the sickling test on the slide): one, less active but enrichable by culture procedure; the other, highly active as shown by the direct test.

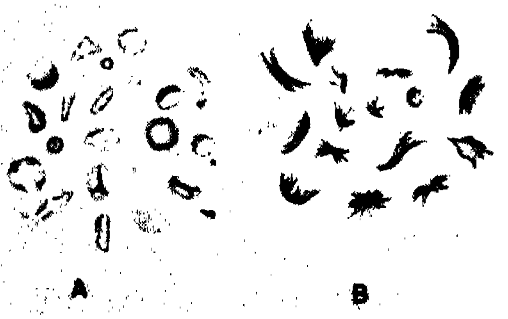

FIG. 1. Jackson washed red cells: A in saline, B in an enzyme broth prepared from feces. The first characteristic figures in B were seen in 8 minutes. The drawings were made after 1 hour.

The appearance of the red cells in the test is clean cut. The successive changes in shape from the normal round form of the red cell to the fine and delicately bent figures occur rapidly, and their occurrence is indicative that "red cell sensitivity to the blood-group-enzyme (Schiff's substance)" is present.

The necessity for additional studies in this field is emphasized. Further investigation of the significance of the occurrence of this sickle-accelerating substance in human disease is in progress.

The rapid sickling of the red cells obtained from two negroes, in the enzyme-containing media, is shown in Figs. 1-3. Jackson suffered from sickle-cell anemia, while Eddy had the sickling condition without anemia. Both were chosen because of their O blood group, to avoid any interference with the group antibodies when plasma was added.

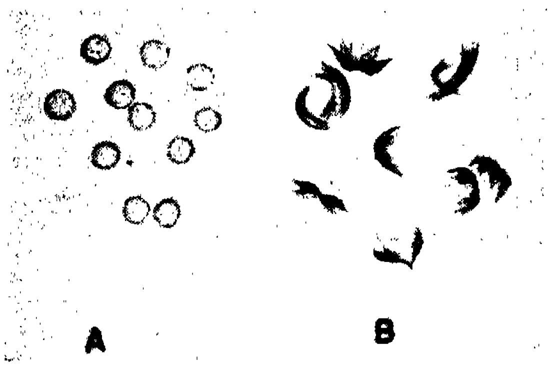

FIG. 2. Eddy washed red cells: A in saline, B in an enzyme-containing natural plasma (from a case of cirrhosis of the liver). The first characteristic figures in B were observed after 20 minutes. The picture was drawn after 1 hour.

The development of the successive changes in enzyme-sensitive sickling red cells, leading to the so-called "sickle," is characterized by many distinctive features which will be described in detail later.

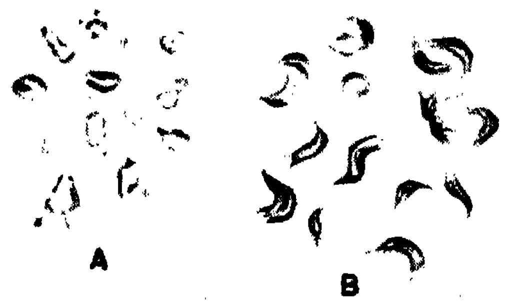

FIG. 3. Jackson washed red cells: A in saline, B in an enzyme-containing plasma (from a case of toxemia of pregnancy). The first characteristic figures appeared after 30 minutes. The drawing was made after 6 hours.

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IN THE LABORATORY

Adaptation of the Silicomolybdic Acid Method for the Estimation of Morphine to the Photoelectric Colorimeter

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In 1937 Snell and Snell (*2*) published a method for the quantitative determination of morphine in tissues and biological fluids, based upon the fact that morphine reduces silicomolybdic acid in alkaline solution to a blue product suitable for colorimetric analysis. These authors found determinations by this method to be accurate to about 2 per cent for 2–7 mg. of morphine. One of its advantages is that silicomolybdic acid is not reduced by any of the constituents present in a trichloracetic acid extract of tissue slices after incubation (*1*).

We have modified and adapted this method for use on a semimicro scale with the Evelyn photoelectric colorimeter. A strict proportionality is obtained up to 0.7 mg. of morphine, with only slight deviation from a linear relationship above this amount.

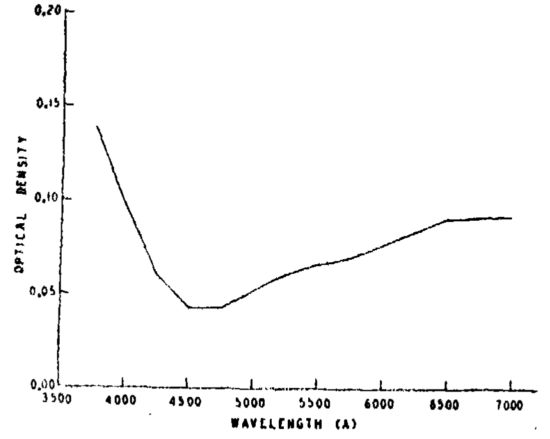

Fig. 1

A standard curve is obtained by introducing various amounts of morphine sulfate (0.1–1 mg.), in 5 cc. of distilled water, into 25-cc. volumetric flasks. This can be accomplished by adding various amounts (0.5–5 cc.) of 0.02 per cent morphine sulfate·5 H_2O to the flasks, followed by that amount of distilled water necessary to make a total of 5 cc. Next, 4 cc. of silicomolybdic acid reagent, prepared according to the method described by Snell and Snell, is added to each flask, followed by 0.5 cc. of 5 per cent trichloracetic acid. Finally, 10 cc. of 5 per cent ammonium hydroxide is added. A reagent blank in which morphine is omitted is also prepared. The volume is diluted to 25 cc. with distilled water, shaken vigorously, and allowed to stand at room temperature for 25 minutes. It is then transferred to colorimeter tubes and read on the Evelyn photoelectric colorimeter, using the 10-cc. aperture and a No. 660 filter. The reagent blank is used to obtain a center setting. Spectrophotometric study showed a plateau of maximum absorption, in the visual range, between 6,700 and 7,000 A. (Fig. 1), with a possible peak in the ultraviolet which could not be investigated with existing facilities. Filter No. 660 has transmission limits at 635–720 mμ. L (photometric density) is plotted against the amount of morphine sulfate present in milligrams (Fig. 2, A).

Recoveries from tissues incubated with morphine were also carried out, using more than 0.5 cc. of 5 per cent trichloracetic acid (per 25 cc. total volume) to stop enzymatic activity; recoveries ranged from 93 to 110 per cent. However, 0.5 cc. of this reagent seems to be optimal for good linearity above 0.7 mg.; it is therefore suggested that, in recoveries of morphine from tissues, enzymatic activity be stopped by some other protein precipitant, rather than by adding more than the optimal amount of trichloracetic acid.

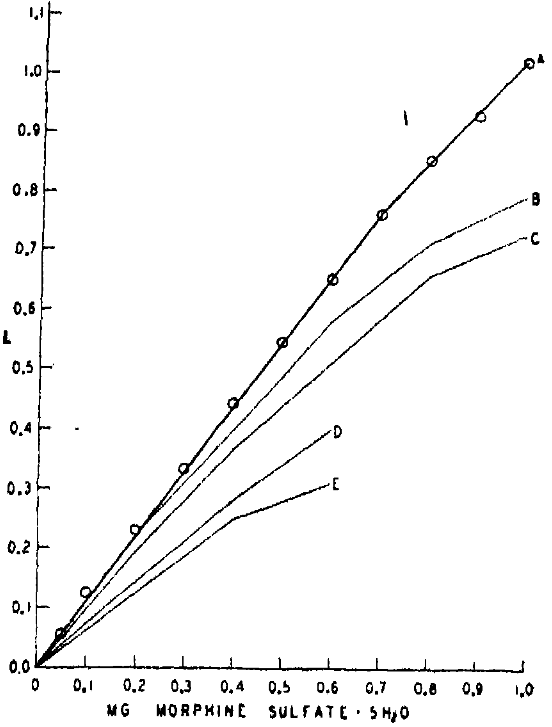

Fig. 2

Some attempts were made to determine the mechanism of the specific action of trichloracetic acid in increasing the sensitivity of the method and the range of the determination. It was found that the pH of the final solutions, prepared as outlined in the method and containing 0.5 cc. of 5 per cent trichloracetic acid, was 9.94–9.98. This final pH was reproduced by substituting, for the trichloracetic acid in the solutions being determined, sufficient amounts of 5 per cent acetic acid (Fig. 2, E), 0.1 N hydrochloric acid (D), 5 per cent monochloracetic acid (C), and 5 per cent dichloracetic acid (B), respectively. The ability of these acids to increase the sensitivity and range of this method *decreased* in the following order: trichloracetic, dichloracetic, monochloracetic, hydrochloric, and acetic acid. This would suggest that the specificity of trichloracetic acid in affecting this method is a function of the number of chlorine atoms attached to the carbon adjacent to the carboxyl group and not a matter of pH or the acetate radical itself.

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Use of Phenol Formaldehyde and Vinyl Resins in Sealing Liquid Mounting Media on Microscope Slides

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A persistent difficulty in the preparation and preservation of certain types of plant materials on microscope slides is the problem of permanently sealing liquid mounting media. Glycerin, lactic acid, lactophenol, and certain other mounting fluids of diverse composition are exceedingly difficult to inure against changes in atmospheric humidity, temperature, and slow chemical reaction with the sealing agent. The dependence upon liquid media for mounting certain plant tissues, although unfortunate, is necessitated by requisite indices of refraction and other physical and chemical properties of diverse mounting fluids. It therefore becomes necessary to employ a sealing compound which gives a reasonable promise of permanence if extensive collections of such plant materials as pollen grains, leaf cuticles, fungus mycelia, and other whole mounts are to be maintained for permanent reference.

Recently, in the preparation of reference collections of root and leaf epidermal tissues for use in the identification of plant fragments in peat and lignitic coals, a need was realized for permanent sealing of glycerin and lactic acid preparations of such tissues. Consideration of the physical and chemical behavior of various synthetic resins and plastics indicated the possibility that phenol formaldehyde and vinyl resins might provide the necessary physical properties and chemical resistance. Preliminary tests showed a p-phenyl phenol formaldehyde resin and a vinyl acetate resin to be very promising for prolonged sealing of noncorrosive and certain corrosive media. These resins, when applied copiously with a brush or pipette to clean glass surfaces, form an effective seal which is not altered by prolonged storage at normal temperatures. In the case of the phenolic resin an accelerated aging test involving 8 months storage at 50° C. with frequent intermittent changes to room temperature has resulted in perfect sealing of lactic acid and glycerin preparations. The vinyl resins have not been subjected to as rigorous tests, but appear to be equally effective.

The phenolic resin showing the most desirable properties for a sealing agent is a p-phenyl phenol formaldehyde compound containing tung oil and a metallic soap as oxidizing agent. The resin is prepared and sold as a commercial varnish and has the syrupy consistency of a thick oil. The setting of the liquid to a solid is complex chemically, involving solvent evaporation, oxidation of the tung oil, formation of colloidal systems, and polymerization of the resin. The dried and polymerized resin is exceedingly hard, yet slightly elastic, shows extreme adhesiveness to glass, and is extraordinarily inert chemically. When cured by drying and especially by heating to about 50° C., the resin is completely inert to ordinary organic solvents such as alcohols, hydrocarbon solvents, and halogenated hydrocarbons. Resistance to mineral acids was tested by ringing lignin residues of wood sections prepared with 72 per cent sulfuric acid. The resin shows effective sealing of the strong acid after 3 months storage at 40° C. A slight carbonization at the edges of the cover glass occurred shortly after sealing, presumably by action on the tung oil. In the case of organic acid media such as lactic acid and lactophenol, clouding of the resin may occur near the interface with the mounting fluid. This cloudiness does not appear to progress after polymerization of the resin at 50° C., and no tendency has been observed for the mounting fluid to become cloudy by emulsification of the sealing agent, as is frequently the case with compounds such as Noyers cement after prolonged storage.

For best results the p-phenyl phenol formaldehyde resins should be kept in a large stock container of quart capacity or more and drawn off only when needed. Small portions of the liquid resin, when kept in dropping bottles or similar containers, set to a gel within a day or two and are useless after jelling since the material becomes insoluble in organic solvents. When still liquid, the resin may be thinned with neutral xylene or ethyl acetate. The tendency to gel after exposure to air can be obviated by proper handling.

Slides, after ringing with the resin, may be dried for 8–24 hours and placed on a warming table or in an incubator to complete the polymerization of the resin. Some change in the color of the resin accompanies polymerization, resulting in an amber yellow. The resin shows no wrinkling by shrinkage after slow drying and polymerization on the glass. Clean glass surfaces are essential for perfect sealing, although excess glycerin or other liquid at the edges of the cover glasses may be effectively sealed if it is not sufficiently copious to form a film between resin and glass.

Phenolic resins of the type described here are produced by the Bakelite Corporation, New York City. The commercial product used in the writer's laboratory is prepared by the Brooklyn Varnish Company under the trade name of Tufon #74.

The vinyl resins tested as sealing agents showed great variation in physical properties and resistance to mounting media. Their advantages are ease of solubility in a wide range of organic solvents and clear, glass-like appearance. A vinyl acetate resin (Balkelite Corporation No. AYAF) proved most useful as a sealing compound, although its texture, chemical inertness, and adhesive properties are inferior to phenolic resins. It may be dissolved to desired viscosity in 95 per cent ethyl alcohol, butyl acetate, dioxane, ethylene dichloride, and other organic solvents. The vinyl acetate polymer appears to be inert to glycerin. The solubility of certain vinyl resins in ethyl alcohol containing as much as 50 per cent water suggests its use in the preparation and embedding of whole mounts of plant and animal tissues in which complete dehydration should be avoided. Vinyl acetate resins are thermoplastic and remain somewhat flexible at room temperature.

Brief experience with the physical and chemical properties of certain industrial plastics has suggested that many other uses for such compounds may be found in histological techniques adapted for plant tissues. Reliance on the tried and true methods need not be sacrificed in the development of these new techniques or new materials for older techniques.

An Effective and Nontraumatic Method of Handling Monkeys

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A technique which we use for catching monkeys preparatory to administering anesthesia has attracted sufficient favorable comment from monkey handlers who have witnessed its operation to warrant a brief note.

The two essential items of equipment are (1) the transport cage and (2) the square-hoop net, illustrated in Fig. 1. The transport cage, which measures 13 x 16 x 20 inches, is equipped with a sliding door on each end; its sides may be made of wire mesh to facilitate observation. The hoop of the net is constructed of ⅜-inch rod. Its size (10 x 13 inches) is such that it fits easily into the transport cage.

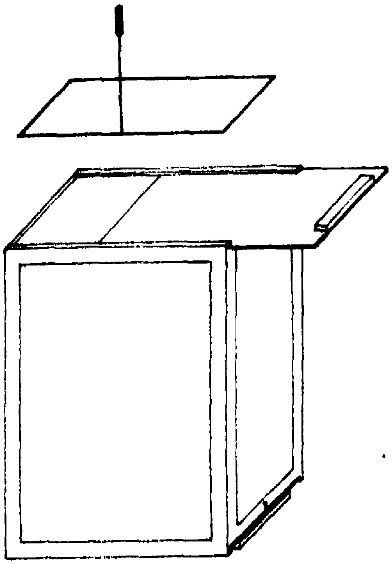

FIG. 1

The first step in the procedure is to chase or lure the monkey into the cage. This can be accomplished with surprising ease, for rhesus monkeys, after a little experience with the cage, react to it almost as though it were a haven of refuge. Once the animal is inside, the cage is set on end. The net is then placed in position over the sliding door, which is now on top. When the door is withdrawn, the net is moved down over the monkey. The lower door is then withdrawn and the hoop held against the floor. When the cage itself is lifted off the net, the enmeshed monkey lies helpless at one's feet.

The entire procedure is tolerated with a minimum of emotional upset for both monkey and man. Using this technique, a single unassisted worker can carry out intraperitoneal or subcutaneous injections. The various uses to which the method may be put are self-evident.

Preservation of *Plasmodium vivax* by Freezing

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There are several methods of fever therapy for neurosyphilis, but induced malaria, either alone or combined with other agents, remains the method of choice of many syphilotherapists. A serious limitation to the more general use of malaria therapy has been the difficulty of providing a constant, readily available source of parasites. Plasmodia do not remain viable in blood under the usual conditions of storage (room temperature and icebox) for more than a few days (*4*). Preliminary results of preserving *Plasmodium vivax* by low-temperature freezing suggest that this may prove a practical method of long-term preservation.

Preservation of protozoa by freezing is not new. Turner (*5*) was able to maintain *Treponema pallidum* and *pertenue* in a viable state at low temperatures for long periods of time. Coggeshall (*1*), studying human, avian, and monkey malaria parasites, reported failure with a process involving rapid freezing at −72° to −80° C. and slow thawing, but when thawing was effected rapidly, monkey parasites were preserved successfully for as long as 70 days. Others (*2, 3, 7*) have been able to preserve the various parasites of bird malaria at temperatures of −50° to −70° C. for long periods of time. Recently Weinman and McAllister (*6*) have reported the freezing and prolonged storage of several types of pathogenic human protozoa with conservation of virulence. Although human plasmodia were not studied, the preservation of *P. lophurae* in the frozen state for long periods was confirmed. Russell (*4*) has alluded vaguely to low-temperature freezing of human malaria parasites as a means of preservation for use in therapeutic malaria, but provided no documentation.

Since we have been unable to find reports of preservation of human plasmodia by freezing techniques, we wish to record the successful transmission of malaria to three subjects by inoculation of blood infected with *P. vivax* which had been frozen and maintained at low temperatures for periods of 10–15 days.

The donor from whom the strain of parasites was originally obtained was H. K., a veteran of service in New Guinea, who had been suffering from recurring attacks of vivax malaria. At the time of bleeding, blood smears showed many young ring forms of *P. vivax*; a rough estimate of parasite density was approximately 10,000/mm.^{3}. Twenty cc. of blood was withdrawn into 3 cc. of 4 per cent sodium citrate solution, of which 10 cc. was immediately injected intravenously into D. M., a neurosyphilitic receiving penicillin therapy. Five cc. of the remainder was transferred to a thin-walled glass test tube and rapidly frozen at a temperature of −75° C. by immersion in alcohol-dry ice mixture, the tube being rotated by hand until the blood became solidified. The tube was then transferred to a dry-ice box for storage at approximately −50° to −70° C. Fifteen days later the frozen blood was thawed by immersion in a water bath at a temperature of 40°–42° C., and 4 cc. was injected intravenously into patient L. H. Ten days later this recipient of the preserved parasites developed a (rectal) temperature of 40° C., and blood smears showed ring forms of *P. vivax*.

Patient D. M., who had received 10 cc. of infected blood directly from H. K., the original donor, developed a paroxysm 40 hours after inoculation, and many ring forms of *P. vivax* were found in the peripheral blood. After several paroxysms, when the parasite count was approximately 5,000/mm.^{3}, blood from D. M. was withdrawn into citrate. Approximately 2–3 cc. of this citrated blood was transferred to each of several small pyrex glass test tubes, which were closed with cork stoppers; and, as before, the blood was frozen by immersion in alcohol-dry ice mixture, then transferred immediately to a dry-ice box for storage. After a 10-day period of storage this blood was thawed, again by immersion in a water bath at a temperature of 40°–42° C. Several tubes which cracked during either freezing or thawing had to be discarded. About 4 cc. of the remaining thawed blood was injected intravenously into patient V. V., who on the 9th and 10th days after inoculation developed a low-grade fever with peaks of 37.8° and 38.0° C., respectively, but parasites were not demonstrated until the 11th day, when the patient had a shaking chill with fever of 41° C.

After two more paroxysms, the parasite density having risen to approximately 1,500/mm.^{3}, V. V. was used as donor for the third experiment. The bleeding, anticoagulant, and freezing process were carried out in the manner previously described, with the exception that small, plastic, screw-capped vials were employed as containers. Freezing and transfer to the storage compartment were completed within ½ hour after bleeding. Fifteen days later the preserved blood was rapidly thawed (as before) and 6 cc., the contents of two vials, inoculated intravenously into each of two neurosyphilitics receiving penicillin therapy. After an interval of 9 days one recipient (E. M.) had onset of periodic episodes of chilliness, headache, and malaise accompanied by slight rises in temperature (maximum, 38.1° C.). The occurrence of this symptom complex followed a tertian pattern, but plasmodia were not demonstrated until the 19th postinoculation day, thick films having been negative on the 10th, 15th, and 17th days. On the 20th day a paroxysm occurred with elevation to 39.4° C.

Removal of the second recipient from the hospital during the incubation period terminated observation. The result of this inoculation is therefore not known.

It should be noted that the freezing and thawing process resulted in almost complete hemolysis of the red blood cells and that the staining characteristics and morphology of the parasites were considerably altered. Of three patients inoculated successfully, one recipient of the hemolyzed blood had a mild chill immediately after injection, with fever to 38.0° C., one had no apparent reaction, and one suffered a simultaneous febrile Herxheimer reaction (penicillin) which masked any unfavorable effect of the inoculum.

Many factors which may influence the success or failure of preservation of human malaria parasites by freezing remain to be studied. Among these are the age of parasites when frozen, the speed of freezing and of thawing, the temperature range during storage, and the anticoagulant used. Studies are continuing to determine the effects of altering these variables, with the objective of developing a practical, reliable method of preserving human plasmodia for long periods.

It is suggested that this method may be used to provide a blood bank of malaria parasites for use in malaria therapy of neurosyphilis, and for preserving strains of human plasmodia for experimental purposes.

Addendum. Since this report was submitted for publication, three additional patients have been inoculated successfully with blood containing *P. vivax* preserved by freezing. In one instance, the blood had been frozen for 37 days.

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Intraneural Bipolar Stimulation: A New Aid in the Assessment of Nerve Injuries

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Clinical observation may sometimes lead to erroneous conclusions concerning regeneration in peripheral nerve injuries. Such instances occur when a patient, despite neurotization of a muscle, remains incapable of voluntary movement or, conversely, when overlap innervation by a neighboring nerve seems to give evidence of regeneration although the nerve in question is actually interrupted.

The extent of regeneration of a nerve may often be clearly ascertained by surgical exploration, with electrical stimulation of the exposed nerve and observation of the reaction in its muscles. A means of obtaining such evidence without an operation has been devised.

Normal peripheral nerves may be excited by electrical stimulation through the intact skin. However, to excite the much less irritable regenerating nerves, stimulation over the skin (or with one electrode within the nerve) must be of such intensity as to result in mass contractions of adjacent muscles. This spread can be avoided and a small stimulus made effective if the current density about the nerve is increased by inserting both electrodes into or near the nerve.

Two sterile #25 hypodermic needles are introduced through the prepared skin, separated by a distance of 1–2 cm., into or close to the nerve in its longitudinal axis. A site of stimulation can be so chosen as to be proximal to the muscles in question and still at an area where the nerve is well defined in its position by surface topography. An effective stimulus is afforded by applying to the two needles a current of less than 5 milliamperes. Alternating and direct currents are equally satisfactory. Any of the usual stimulators may be used; in fact, even the make-brake stimulus delivered by a 1½-volt dry cell in an adjusted flashlight is sufficient. The current is gradually increased until a maximal contraction is obtained in the innervated muscles. The strength of contraction is estimated or measured. In the absence of motor response the presence of some regenerating nerve fibers at the point of stimulation is indicated by a tapping or burning sensation projected into the skin distribution of the stimulated nerve. If no sensory effect can be elicited, one may assume complete absence of regeneration only after having varied the position of the needles several times to preclude the possibility of poor contact with the nerve.

Intraneural bipolar stimulation has been carried out on over 1,000 patients at Cushing General Hospital during 1945 and 1946. Positive responses were followed by the return of voluntary contraction of variable degree. The absence of response could be confirmed, in most instances, by stimulation of the exposed nerve at the subsequent operation performed because of this finding. The first appearance of muscle contraction on intraneural stimulation permitted calculation of a mean nerve-growth rate of 1.4 mm./day. Long-term follow-up studies have shown that when, in a given patient, the schedule for beginning contraction of various muscles, predicated upon this growth rate, was not maintained within narrow limits, appreciable recovery of function could not be expected by further waiting.

Intraneural stimulation is an objective and easy means of discovering the extent of spontaneous or postsutural regeneration in an injured nerve. Needless surgery is avoided, and necessary surgery is anticipated because of the possibility of determining with greater accuracy and at an earlier time the presence or absence of adequate nerve regeneration.

Interlaboratory Comparison of Measurements of I^{131}

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Radioactive iodine, I^{131} (8.0 days), is coming into use in increasing quantities in medical research and clinical treatments. It is desirable to have quantitative measurements of this material which are reasonably accurate for many of the purposes for which this isotope is used. Since quantitative procedures for measurements of this type are still in a developmental stage, many of the users as well as the producers have requested some form of intercomparison to determine how accurately measurements are made at present, with the aim of discovering and correcting any serious disagreements.

As a first step in this program the National Bureau of Standards procured a sample of I^{131} from the Clinton Laboratories and prepared from it a number of identical 25-ml. samples which were distributed to approximately 40 hospitals, universities, and similar institutions using this isotope or interested in its measurement. They were requested to measure this sample, which was approximately 1 rutherford (10^6 disintegrations/second) total activity, and to report the results. Replies were received from 30 of these institutions, 26 of which reported results in terms of disintegrations per second. The remaining 4 gave values in counts per second, which could not be interpreted in terms of disintegration rates.

The reported values, plotted in Fig. 1, give some idea of the spread. One value was very high (nearly 100 times the average of the others), which seems to indicate an error in reporting rather than measurement. Neglecting these values, the average value reported was 3.0×10^4 disintegrations/second/ml. of 0.75 rutherford for the 25-ml. sample. The lowest value deviated from the average by 40 per cent and the highest by 80 per cent.

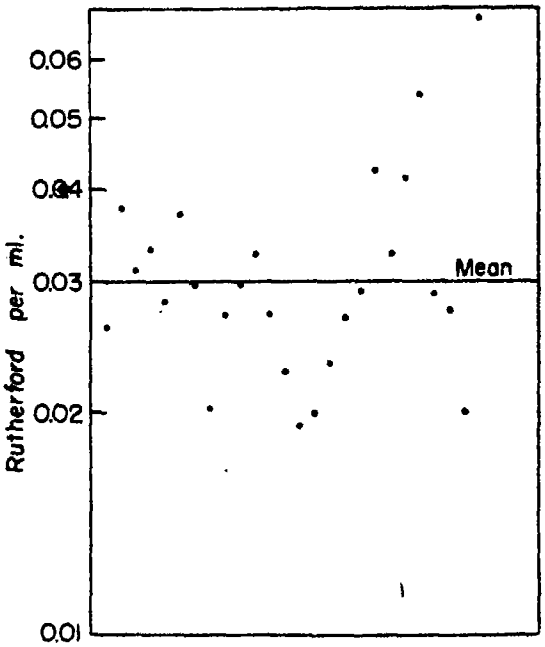

Fig. 1

This preliminary distribution serves only to focus attention on the magnitude of the discrepancies and the need for more accurate standardization. It is certain that much of the variation reported above, in those cases where beta-ray counters were used for measurement, can be reduced by the use of the RaD + E beta-ray standards now available from the National Bureau of Standards. These standards are undoubtedly correct in absolute value to ±5 per cent. By the use of the nominal value, as stated in the certificate accompanying these standards, all counter measurements can be placed on a common basis of comparison to a somewhat higher accuracy.

One sample sent out by us was reported contaminated by a growth of streptococcus on receipt by the cooperating institution. The difficulty of bacterial growth in preparation of P^{32} and I^{131} has been encountered by others. This indicates that all containers should be carefully sterilized before filling, a precaution which we will adopt in the future. Bacterial contamination interferes seriously in measurements which require preparation of aliquots of the original sample.

Since another program of intercomparison is to be started in the immediate future, we would like to hear from other institutions or investigators who may not have been included in the preliminary distribution and who wish to cooperate in the measurement. The method of distribution of calibrated samples is about the most satisfactory way of standardizing in various laboratories measurements for radioisotopes of half-value period too short for the preparation of permanent standards. The National Bureau of Standards proposes to extend this service to other short-period isotopes as the demand arises.

Book Reviews

Thermodynamics for chemists. Samuel Glasstone. New York: D. Van Nostrand, 1947. Pp. viii + 522. $8.00. Series price, Vol. I, $7.00.

This book on elementary chemical thermodynamics should find a receptive audience among students of chemistry and chemical engineers. In a clear, relaxed style the author presents those parts of thermodynamics and statistical mechanics that have stood the test of experiment and may deserve the name canonical. Almost every principle or formula is followed by numerous, well-selected tables, graphs, and problems, and the author has had the grace to work out, numerically, representative examples, so that the reader is not left in doubt as to the units involved. This is in wholesome contrast to the current practice of the proud Shakuntas, who delight in introducing systems of units that confound both the catechumen and the learned.

In the main, the subject matter covered does not extend beyond that given by Gibbs, Lewis and Randall, Fowler, Epstein, and Tolman; but the beginner or the practicing engineer still finds these greater treatises somewhat difficult; and, moreover, he is not yet certain which parts have proved most useful. The author has chosen those having maximum utility.

One may find here, as in all books, debatable statements. For example, the definition of energy (p. 6) causes a pang; the discussion of the exceptions to the so-called third law (p. 196) provokes the reader to wonder whether the third law is true and the crystals imperfect, or the crystals perfect and the third law false.

It is noteworthy that some part of the book was done at the university of a state (Oklahoma) famous for its fertility, fine spirit, and amazing human color. It is characteristic of this country that this same state should give encouragement to a scholar.

When the elite of science, the engineers, and students come to examine *Thermodynamics for chemists*, the first may scoff, but the two latter will probably remain to pray.

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College technical physics. Robert L. Weber, Marsh W. White, and Kenneth V. Manning. New York-London: McGraw-Hill, 1947. Pp. viii+761 (Illustrated.) $4.50.

This is a general textbook of physics for college students of science and engineering. The order of presentation and treatment of subject matter are conventional and the style straightforward and clear. The use of mathematics is confined to algebra and trigonometry, and even the latter is used sparingly. Calculus is avoided, although the increment notation is occasionally employed.

Numerous solved problems are interpolated at strategic places in the text, and the proper handling of units is carefully explained. Suggestive questions accompany the problems at the end of each chapter.

The book is well illustrated by numerous line drawings. An interesting feature is the introduction of portrait sketches of the Nobel Prize winners in physics from Röntgen to Bridgman. These are placed in the chronological order of award as chapter headpieces. Though this has an obvious advantage, it also possesses the drawback of providing little or no connection in general between the field of work of the prizewinner and the material of the chapter at the beginning of which his portrait appears. It must be confessed that the poor quality of the paper scarcely does justice to the sketches.

The book is weak on modern physics. Only 16 pages are devoted to 20th-century developments. The quantum theory is disposed of in a few sentences which give no conception of its importance, and relativity is barely mentioned in connection with $E = mc^2$. Even such things as the photoelectric effect and thermionic emission get scarcely more than a passing mention. This seems regrettable in a book intended for a fundamental course in elementary physics. For students going on to engineering, the treatment of thermodynamics is not sufficient, and the statement of the second law is not precise. The reviewer regrets to see no definition of mass. It has been shown that this fundamental concept *can* be made clear in an elementary book, and it seems only fair that the student should get it straight, even in his first course.

R. B. LINDSAY

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Sequential analysis. Abraham Wald. New York: John Wiley; London: Chapman & Hall, 1947. Pp. xii + 212. $4.00.

In the reviewer's opinion this book is very useful and valuable and should be possessed and digested by every teacher of statistics and by every professional statistician.

Sequential analysis, a method of testing statistical hypotheses, consists of making a certain calculation after each observation is made and deciding, on the basis of this calculation, whether to (1) accept the hypothesis under test, (2) accept the alternate hypothesis, or (3) postpone judgment, pending the examination of more data.

The advantages of the method appear to be that (1) it results, on the average, in a great reduction in the number of observations required for a given degree of reliability; (2) it appears simpler than prevailing methods of analysis; and (3) most numerical calculations can be made in advance of collecting the data.

Sequential analysis is a method by which statistical data are analyzed continuously as they become available. In the book there is presented a particular method of sequential analysis, the so-called sequential probability test, to test statistical hypotheses. The idea of sequential analysis is not new. It appears that the idea was first conceived by Romig and Dodge, who gave us a double sampling procedure. Later there was a multiple-sampling scheme by Bartky, and, also, the idea of chain experiments was discussed by Hotelling in 1941.

In the reviewer's opinion, sequential analysis is not the last word in testing procedures for the general problem of efficient testing. Too little attention appears to be given to operational testing situations to determine the pertinent factors that are involved. However, the technique appears to be useful when the test is destructive and when the cost of testing an item is large.

The book is divided into three parts and an appendix. Part I includes: (1) an elegant discussion of the elements of the current theory of testing hypotheses, (2) a clear and concise general statement of a sequential test of a statistical hypothesis, (3) the nature and meaning of a probability ratio test, and (4) an outline of a theory of sequential tests of simple and composite hypotheses against a set of alternatives. In Part II we have certain simple applications of the theory to very special cases involving the binomial and normal distribution functions. It would have been interesting and useful to have had, in addition, illustrations of less common cases. Part III outlines a possible approach to the problem of sequential multi-valued decisions and estimation. As is well known to the author of the book, this field is unexplored, and in it there is much left to be done. In the appendix the author gives certain mathematical derivations pertinent to the theory of sequential testing.

In the reviewer's opinion, the book is well and clearly written and may be read and understood by those who have no advanced mathematical training.

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Diseases of the nose and throat. (3rd ed.) Charles J. Imperatori and Herman J. Burman. Philadelphia: J. B. Lippincott, 1947. Pp. xxvi + 576. (Illustrated.) $12.00.

This revised standard work is addressed to surgeons and therapists in the field of rhinolaryngology. It stresses the point of view that modern surgery is performed not merely to correct pathology or deformity, but to achieve an optimum postoperative functional result for the patient. The new material introduced in the present edition has to do chiefly with the oral manifestations of nutritional disturbances, vitamin deficiency, and the use of sulfonamides and penicillin, particularly in relation to intracranial complications. The chapter on radiation therapy has been completely revised in the light of recent clinical research. The volume is presented as a working manual for the diseases of the nose and throat written in terse sentences and arranged in well-outlined, almost tabular, form. The condensed text is complemented by 480 good illustrations, a large number of them actual photographs and a fair number in color. Supplementing 49 chapters by the authors are three by other contributors: Frederick M. Law, on "Roentgen Examination of Nasal Accessory Sinuses"; Ira I. Kaplan, on "Radium and Roentgen Ray"; and Andrew A. Eggston, on "Laboratory Aids." Although the volume is supplied with a very good index, it is almost wholly lacking in references to pertinent literature and leaves the reader at a complete loss in reference to the sources for statements made or where further elaboration of techniques and topics could be secured.

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Scientific Book Register

BOURIQUET, G. *Les maladies des plantes cultivées à Madagascar.* Paris: Paul Lechevalier, 1946. Pp. 545. (Illustrated.) 1200 fr.

BOYCE, JOSEPH C. (Ed.) *New weapons for air warfare.* (Science in World War II, OSRD.) Boston: Little, Brown, 1947. Pp. xviii + 292, (Illustrated.) $4.00.

CAHALANE, VICTOR H. *Mammals of North America.* New York: Macmillan, 1947. Pp. x + 682. (Illustrated.) $7.50.

CARSWELL, T. S. *Phenoplasts: their structure, properties, and chemical technology.* New York-London: Interscience, 1947. Pp. xii + 265. $5.50.

CROWTHER, J. A. (Ed.) *Handbook of industrial radiology.* (Industrial Radiology Group, Institute of Physics.) London: Edward Arnold, 1946. Pp. viii + 203. (Illustrated.) $7.00.

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DENNIS, WAYNE, *et al. Current trends in psychology.* Pittsburgh, Pa.: Univ. Pittsburgh Press, 1947. Pp. vii + 225. $3.50.

EASTMAN, E. D., and ROLLEFSON, G. K. *Physical chemistry.* New York-London: McGraw-Hill, 1947. Pp. viii + 504. $4.50.

HALDANE, J. B. S. *Science advances.* New York: Macmillan, 1947. Pp. 253. $3.00.

KRAEHENBUEHL, JOHN O., and FAUCETT, MAX A. *Circuits and machines in electrical engineering.* Vol. I: *Circuits*; Vol. II: *Machines.* (2nd ed.) New York: John Wiley; London: Chapman & Hall, 1947. Pp. ix + 367; ix + 370. (Illustrated.) $4.25 ea.

LAUFFER, MAX A. *Viruses.* (From 20th Annual Priestly Lectures, 1946.) Ann Arbor, Mich.: Edwards, 1947. Pp. 62. (Illustrated.)

LEROI-GOURHAN, ANDRÉ. *Archéologie du Pacifique-Nord.* Paris: Université de Paris, Institut d'Ethnologie, Musée de L'Homme, 1946. Pp. xviii + 538. (Illustrated.)

MCINTRYRE, A. R. *Curare: its history, nature, and clinical use.* Chicago: Univ. Chicago Press, 1947. Pp. vii + 240. (Illustrated.) $5.00.

NELSON, J. RALEIGH. *Writing the technical report.* (2nd ed.) New York-London: McGraw-Hill, 1947. Pp. xiv + 388. $3.00.

NORD, F. F. (Ed.) *Advances in enzymology and related subjects of biochemistry.* (Vol. VII.) New York-London: Interscience, 1947. Pp. xi + 665. $8.75.

——————. *Heredity and variation in microorganisms.* (*Cold Spr. Harb. Sympos. quant. Biol.*, Vol. XI.) Cold Spring Harbor, N. Y.: Biological Laboratory, 1946. Pp. xi + 314. (Illustrated.) $6.00.

The Nucleus in Relation to Heredity and Sex

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THE NUCLEUS OF THE LIVING CELL IN plants and animals has a most important relation to its activities and functions. It is clear, from the study of cells deprived of their nuclei in a way not to injure the body or cytoplasm of the cell, that the nucleus presides over its fundamental activities, such as growth, elaboration and use of foodstuffs, formation of new cells, and, finally—most important of all—over reproduction. It may, in fact, be stated that the nucleus of the cell in living organisms plays a role comparable to that shown in recent years to be enacted by the nucleus of the atom in the inorganic world.

Only slightly more than a quarter of a century ago, the genius of Rutherford revealed for the first time the nature of the atom and its all-important nucleus. With his truly epoch-making discovery, science passed from the era of the atom as a hypothetical "vortex ring" in an equally hypothetical "ether." Although the students of living matter have not been so frustrated by the exceedingly minute as have the physicists and chemists in the case of the atom, the living cell and its all-important nucleus require for their adequate investigation the highest powers of the microscope.

Equally important for the study of the living cell is the art of instantaneous fixation, at given moments, of its numberless activities. This is comparable to the study of the flight of bullets or similarly rapid movements by the instantaneous camera. Until relatively recently the student of the living cell has had to depend on somewhat slowly-acting preservatives dissolved in, or diluted by, water. The generalizations of cytology, or the science of the minute structure of the cell and its constituent parts, are based on preservative solutions in water of osmic acid, chromic acid, and various combinations of these with one another and with other reagents, as well as organic preservatives such as formaline, etc. These solutions penetrate too slowly to preserve accurately and instantaneously the organization of the fundamental structures of chromosomes at a given moment. We owe to a Beligan biologist (Carnoy) the earliest invention of reliable reagents causing instantaneous death or fixation. These fluids, variously formulated, depend for their rapid and instantaneous action on that extremely penetrating reagent, 100 per cent, or so-called absolute, alcohol. The shrinkage caused by this powerful reagent is controlled by the appropriate addition of a powerful swelling reagent, glacial acetic acid. These two, sometimes with the addition of other substances, for the first time gave us some accurate insight into the organization of the nucleus of the cell, in its active or kinetic stages. As a result of the improvement of Carnoy's procedures by various modifications, we are now in position to undertake at least the beginning of a recording of the structure and activities of the all-important active or kinetic nucleus of the living cell. The knowledge thus obtained appears to make necessary a fundamental revision of the "cell doctrine," particularly so far as the nucleus is concerned.

This is an objectively illustrated, general account of fundamental investigations on chromosomes, which appear to render necessary a revision of our views regarding the relation of the nucleus and its derivative chromosomes to heredity and the determination of sex.

The resting or quiescent nucleus is still relatively a closed book to the cytologist, on account of its extremely minute organization. The active or kinetic nucleus, however, presents structures, chromosomes, which are more easily resolved by our existing visual microscopes; unfortunately, the extreme magnifications supplied by the electron microscope are largely discounted by its very definite limitations in the investigation of active living matter. The relatively low magnifying power of our visual microscopes has limited cytologists in their studies to the examination of the largest available chromosomes of the active nucleus. These are found in the initial stages of reproduction. When a nucleus passes into the active or kinetic stage, it is resolved into a number of units, the chromosomes, which are definite in number in any given case. It was observed in the final decades of the 19th Century that the chromosomes in the active or dividing stages of the body cells were twice as numerous as in the case of the cells concerned in reproduction. It was further clear that when living beings, whether plants or animals, reach sexual maturity, a reduction from the double somatic number to the single reproductive number takes place. This was designated by an English biologist (Farmer) as meiosis, the Greek equivalent of reduction. The fact that the meiotic or reductive chromosomes achieve their halved number by taking on a double size made them particularly favorable, in comparison with other chromosomes, for study with the relatively feeble powers of existing visual microscopes. A further incentive to their study has been supplied by their relation to reproduction, for it has very naturally been believed that a study of the chromosomes on the brink, as it were, of reproduction might throw a revealing light on the process of reproduction itself.

As a result of their large size, which made them favorable objects for microscopic study, the meiotic chromosomes constituting the transition from the double or bodily (somatic) number of chromosomes to the single or reproductive (gametic) have been practically the entire basis of our knowledge of chromosomal structure, to the almost complete exclusion of other equally or even more important types.

Another important limitation of our knowledge of the organization of chromosomes has arisen from the idea that the reduction in chromosomal number in the meiotic stage was merely the result of the fusion of the chromosomes side by side in pairs as reduction or meiosis took place, technically known as synapsis or syndesis. This assumption is the result of a palpable disregard of the structure of the somatic or bodily chromosomes and, above all, of the organization of the hitherto completely structurally unknown reproductive or gametic chromosomes. In the actual state of our knowledge there is no authentic case of the union of chromosomes side by side, for a study of the organization of all types of chromosomes shows clearly that chromosomes become united invariably only end to end. Moreover, the union of chromosomes never takes place at the beginning of a nuclear division (as is assumed in current speculations as to the nature of meiosis or reduction), but at the end (telophase) of the immediately preceding division. It may be added that not only is the union of chromosomes in cell division characteristic of, and confined to, the end of the preceding division, but this situation is likewise an unfailing feature of all chromosomal unions, whether somatic, reproductive, or reductional.

THE STRUCTURE OF CHROMOSOMES

Obviously, since chromosomes are an important and apparently a primitive feature of all nuclear division in the higher plants and animals, a knowledge of their intimate organization is absolutely necessary for an understanding of their relationship to hereditary transmission and the determination of sex. This is essential not only because of the fundamental importance of structure in this connection, but because general ignorance on this subject is unfortunately universally prevalent. Such information as is available on the true situation in this respect has appeared in foreign journals not usually accessible at this time to American cytologists. Further, since information supplied appears as yet to be regarded with general skepticism, a necessarily limited amount of objective evidence in the form of photomicrographs under high magnification is supplied in the present connection.

Fig. 1 represents the anaphase, or advanced stage of nuclear division, in the body cells of the root in the liliaceous genus, *Trillium*, characterized by the especially large size of its chromosomes, which makes them particularly favorable for investigation. The chromosomes are arranged in the two daughter groups characteristic of this stage. If the individual chromosomes are examined, it becomes obvious that they have a complex organization, consisting of a double spiral in which the coils (gyres) cross one another at somewhat regular intervals. This i particularly well seen in chromosomes in the upper lef of the illustration. Similar organization has been universally described in large chromosomes of the meiotic division and has been generally regarded as an exclusiv characteristic and most significant feature of this division. It has, moreover, been interpreted as representing the union of pairs of chromosomes derived from the parental egg and sperm. Since the condition now appears to be universally present in the somatic nuclear divisions, that interpretation obviously can no longer be logically accepted.

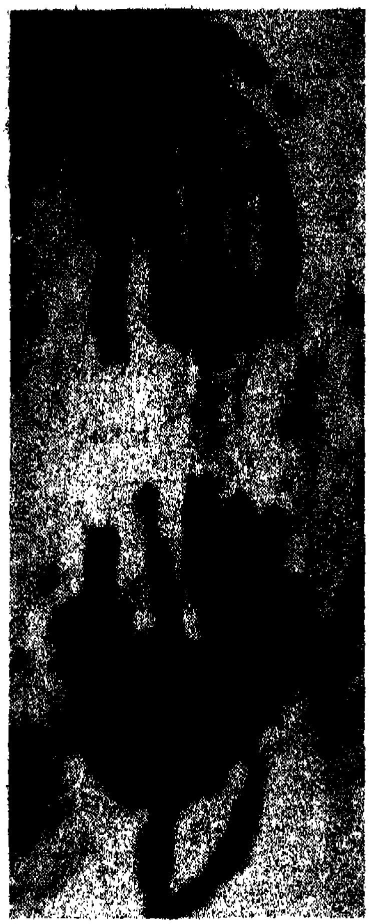


FIG. 1. Anaphase of a somatic division in *Trillium* (× 4,000).

Fig. 2 illustrates objectively in a photomicrograph a somatic division from a root of the common spiderlily, *Tradescantia*. The same complex and double structure can be clearly seen in such of the chromosomes as appear in sharp focus under the very high magnification shown.

Fig. 3 reproduces a comparable stage of division of the nucleus in the developing pollen grain of *Tradescantia*. The upper part of the dividing figure shows chromosomes evidencing the same double, crossing, spiral coils as are seen in the preceding two figures. It is thus objectively clear that all chromosomes have the same and identical structure and all are characterized by the presence of two spiral coils of chromatin (variously known in cytological literature as chromatids or chromonemata). The double chromosomal coiled structure is, accordingly, not confined to the meiotic, or reductional, chromosomes appearing at sexual maturity, as has been practically universally assumed in the genetical literature of the present time.

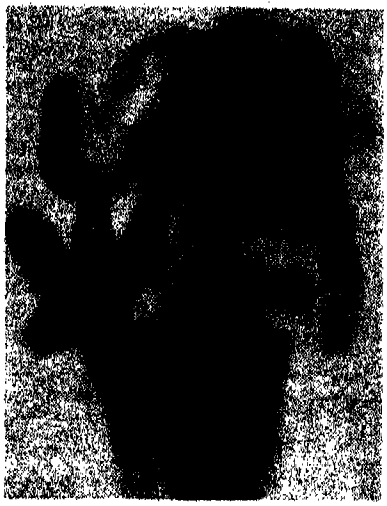


FIG. 2. Anaphase of a somatic division in *Tradescantia* (× 5,000).

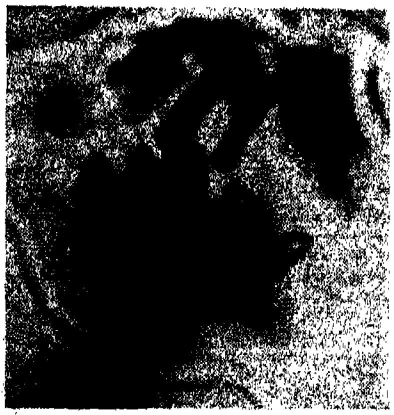


FIG. 3. Reproductive division in the young pollen grain of *Tradescantia* (× 5,000).

Further, if the dual structure of the meiotic divisions marking the advent of the sexual cells or gametes were to be interpreted (as is generally accepted) as the result of the fusion of the double somatic equipment of chromosomes in homologous pairs of opposite sex, a *reductio ad absurdum* is reached, since meiotic, somatic, and gametic chromosomes all exhibit identically the same organization.

Fig. 4 shows a summary and slightly diagrammatic illustration of the situation described above in *Tradescantia*. In *a* appears a side view of the chromosomes at a late stage of nuclear division in a body or somatic cell. The double chromatin spirals can be easily distinguished. A comparable stage from the dividing gametic, or reproductive, nucleus of the pollen grain is shown in *b*. In *c* appears a division from the food substance, or endosperm, of the developing seed, which likewise shows identical features of chromosomal organization. In the three figures are represented side by side chromosomes of three distinct and typical categories, which, nevertheless, show identical internal organization. An earlier stage of division in the meiotic nucleus is illustrated in *d*. Here the chromosomes have become clearly doubled as a preliminary to division of the cell. The same stage in a gametic division in the young pollen grain may be seen in *e*. In *f* is shown a lateral view of the meiotic or reductional division. Obviously, in all these varied types of chromosomes the internal organization is identical. This situation, as has been shown objectively above by photomicrographs, is entirely unfavorable to the current views regarding the relation of chromosomes to inheritance.

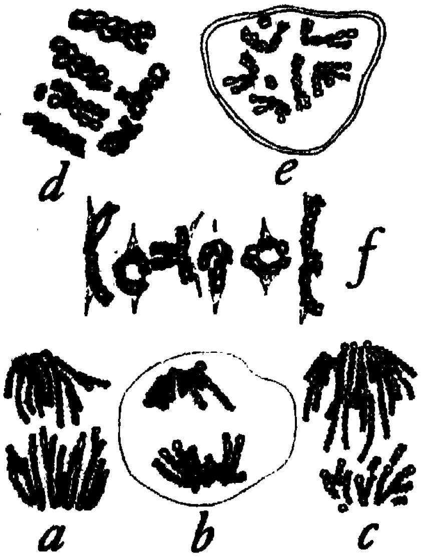


FIG. 4. Drawings of various types and stages of chromosomes in *Tradescantia*.

The present writer has previously pointed out in *Science* (*1*), on the basis of the facts of fertilization, as revealed by improved technique, that the chromosomes present in the fusing gametes, sperm and egg, as well as in the divisions of the fertilized egg itself, are identical in organization. It follows that the doctrine of the side-by-side, or lateral, fusion of chromosomes in the reduction division and the conclusions in regard to hereditary transmission based on that supposed condition have no sound basis in fact.

This situation eliminates also the contradiction that the reductional division preceding the formation of the gametes, in contrast to all other typical nuclear divisions, involves a fusion rather than a division of chromosomes.

There is a further important and, indeed, fundamental conclusion of current cytogenetics, negatived by the facts derived from the objective study of chromosomes by the improved and revealing methods outlined in an earlier paragraph. It has been assumed for several decades that the determination of sex may be brought about by male- and female-producing sex chromosomes, usually designated X and Y chromosomes. These are supposed to make their appearance in the meiotic stage and to persist throughout the somatic or body cell divisions. They have also been described and figured in the somatic divisions of *Drosophila* and other dipterous insects. The present writer has called attention to the erroneousness of this conclusion in such relatively favorable dipterous species as the mosquito (*Culex*) and the blackfly (*Simulium*) (*1*). This fallacy is obvious from a study of the course of chromosomal division in the cells of the body in the two-winged flies or Diptera, which makes it clear that the so-called sex chromosomes originate by division from the same mother chromosomes, exactly as is the case with the other chromosomes of the body. They are thus of identical origin and organization and consequently cannot be in any sense regarded as sex determinants.

The recent course of cytological investigation appears to make it clear that, as in the inorganic world, fundamental characters are concealed in atomic and molecular structures beyond the range of vision of our present visual and even electronic microscopes.

It may also be added that the supposed genes revealed in imperfectly preserved, reproductive chromosomes are merely the crossing points of the double spirals of chromatin, present in all chromosomes. A serious criticism of them in the capacity of structural bases of genetical genes is supplied by their insufficient number. Further, the crossing points of the chromosomal spirals are much more numerous in the earlier stages of the meiotic divisions and become still fewer and fewer as the development of the gametic cells progresses.

Reference

1. Jeffrey, Edward C. *Science*, 1945, 102, 653–656.

Poland in the World of Science

Ignace Zlotowski

Polish Representative to the United Nations Atomic Energy Commission

SCIENTIFIC KNOWLEDGE REPRESENTS A product of multilateral international cooperation. By pooling their individual contributions, scientists of various countries have made possible the developments in science and technology which constitute the foundations of our present civilization. In the course of their work, they are inspired by the thought that they are collaborating with other researchers of the world to solve scientific problems. In fact, international cooperation has always been a powerful stimulant in advancing human knowledge.

That the scientific world is truly a 'one world' has been triumphantly demonstrated by the release of atomic energy. This brilliant achievement in nuclear physics could never have been attained without the scientific and technological knowledge laboriously accumulated for the five decades since the discovery of radioactivity by the French scientist, Becquerel, and the separation of polonium and radium by Marie Sklodowska-Curie. Today it is in the best interests not only of science but also of human welfare to continue assuring close cooperation between the scientists of the world. Science is no longer a complementary element in each country's economic and political life but an indispensable part of it. In this atomic age, scientific progress constitutes the foundation of every nation's future; it is, in fact, the cornerstone of modern democracy.

Unfortunately, many countries devastated by the war are unable today to take an active part in advancing science and technology. Despite their long scientific tradition, they are practically left out in the scientific race toward a better and happier tomorrow. Perhaps the most tragic example of devastation that was brought about by the Nazi barbarians in the field of science was the destruction of scientific and cultural life in Poland. The Nazis pursued a ruthless policy of systematic extermination of intellectuals. Seventy members of the Polish Academy of Sciences perished, while 40–70 per cent of the total membership of university staffs were lost. One recalls here the case of Prof. Kalandyk, of Poznan, who served as a target for bottles thrown at him at a party for SS men. Hand in hand with the destruction of intellectuals went the eradication of Polish cultural life. Six thousand and four hundred schools, 3,350 cultural institutions, 16,000,000 books, and 700,000 collections and maps were destroyed by the Nazis.

In spite of this overwhelming destruction, Poland is making tremendous progress in restoring higher education. Most of the universities that existed in prewar Poland have been reopened, and seven new ones have come into existence since the end of the war. Several universities and cultural institutions previously located in the eastern territories, which formerly belonged to Poland, have been transferred to Poland proper. The Jan Kazimierz University of Lwow, for example, has become the University of Wroclaw, and the Stefan Batory University of Wilno is now the Mikolaj Kopernik University of Torun. Among the present universities, there are a number of private institutions such as the Catholic University of Lublin and the School of Political Sciences at Warsaw. In fact, the total student enrollment at private universities in the school year of 1945–46 was 7,142, as compared with 6,022 in 1933–34. In addition to the universities, there has been a revival of the so-called "nonacademic schools," which grant certificates or professional diplomas upon graduation but do not issue degrees. In this category belong normal schools and higher agricultural schools.

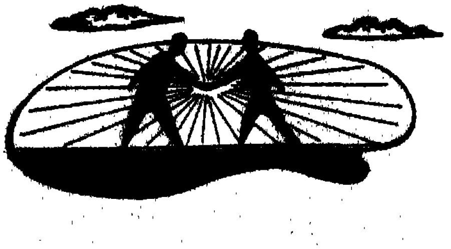
What are the problems that now confront the universities of Poland? Perhaps the following figures will help to answer the question. Nine hundred and eighty-two university chairs are occupied, while 630 are still vacant. Twenty-five per cent of all laboratories are still closed because of lack of personnel and equipment. There are present in Poland only 739 permanent professors and as many as 1,453 so-called "temporary professors" who either rotate among a few universities or teach simultaneously at a number of schools. It is interesting to note the great discrepancy in numbers between undergraduate and graduate students. In 1946–47 52,000 undergraduate and only 200 graduate students were enrolled. This lack of proportion is, of course, a result of the war. During that time the schooling of a great many young people was interrupted, and only now are they able to start where they were forced to leave off. Thus, in the school year 1945–46, 1,850 undergraduate and only 211 graduate students received diplomas. Another striking fact is that out of those 1,850 undergraduate students, only 445 were women; out of 211 graduate students, only 16. This is, of course, also due to the conditions produced by the war.

It must be remembered, however, that the blow dealt by the Nazis to Polish science is not the first one that Poland has suffered. The rich Polish scientific tradition was interrupted more than once during the last 150 years. It has been the strange fate of the country that so many of her outstanding scientists lived abroad. Prior to World War I, national persecutions forced numerous Polish scientists, among them Marie Sklodowska-Curie, to leave their native land. Between the two wars, the Fascist regime ruling Poland caused many scientists to emigrate abroad, and, with the outbreak of World War II, more scientists sought refuge in foreign countries. The largest damage to Polish science was brought about by the planned extermination of scientists pursued by the Nazis.

If the world wants to benefit from the contributions of Polish scientists as it has done heretofore and at the same time revive Polish science, certain definite steps can be taken. First of all, contacts between Polish scientists and those in other countries must be renewed and maintained. This would involve supplying Polish scientists with books, periodicals, and other scientific publications as well as much-needed equipment. Secondly, the new crop of young scientists emerging from all classes of Polish society should be assisted. For the first time in Poland's history, the universities are open to all classes, in contrast to the prewar policy when higher education was available only to privileged groups. In this respect a number of scholarships might be established to enable promising Polish students to study abroad. Of course, aid coming from abroad would not solve all the problems which are confronting Poland. There is a large area of endeavor where the burden falls entirely on the Polish scientists themselves. Fully aware of this obligation, those who survived Nazi brutality are utilizing their knowledge and ability to build Polish science on a real democratic foundation.

The problem of helping devastated countries to revive their national scientific life ought to be solved by all scientists of the democratic world, in order that the international community of scientists may become a living reality. Poland is only one example of a country with new possibilities for scientific work and scientific culture in need of help to develop its potentialities. Such help not only will prove to be of great importance to Poland but will also bear scientific fruits of benefit to humanity.

Everyone, and particularly the scientist, realizes to what extent modern science can be used for destructive purposes. The bright opportunity to use science constructively by rebuilding destroyed countries now presents itself. By so doing "the brotherly spirit of science which unites into one family all its rotaries of whatever grade and however widely dispersed throughout the different quarters of the globe"—as Thomas Jefferson pointed out—will manifest itself by utilizing science to create conditions favorable for a free, full, and happy life for peoples all over the world.



Association Affairs

Association Membership Dues Increased

Nearly every scientific society and educational institution is now under financial pressures as a consequence of greatly increased costs of operation. Most of them a year or more ago increased their dues, tuitions, etc., and many of them are making further increases this year. But by strict economy the American Association for the Advancement of Science has heretofore not had to make any increases in the dues of its members. Now it must do so.

Although all operating expenses of the Association have risen greatly in recent years, the present increase in annual dues of members from $5.00 to $6.50 is barely sufficient, for the sake of illustration, to meet the increased costs of printing *Science* and *The Scientific Monthly*. Of course, the increase in dues could be measured against other expenses of the Association, but not so simply. Since every member of the Association receives with his membership either *Science* or *The Scientific Monthly*, the increase in dues will provide for the increased costs of the journals but not for increases in other expenses. These are being met by economies which are possible with a greatly increased membership, and from increases in receipts from advertising in *Science* because of its correspondingly larger circulation.

In 1940 there were about 21,000 members of the Association; now there are 33,000, 6,000 new names having been added to the membership roll in the past 12 months. Less than four years ago the circulation of *Science* was 17,000; now it is 25,000, the increase putting it in a higher class as an advertising medium. When its circulation exceeds 30,000 (within 18 months?), it will rate still higher as an advertising medium. These considerations make clear the fact that when members of the Association nominate their friends for membership they are indirectly giving much needed financial assistance.

The Association's weekly journal, *Science*, is in many respects similar to its prototype, *Nature*, a weekly magazine edited and published by Macmillan & Company, Ltd., the great scientific book publishers in London, England. *Nature*, now in its 160th volume, has a wide circulation throughout the world. In format and contents *Science* is generally similar to *Nature*. Their pages are of the same size, their issues normally consist of 48 pages of text and advertising, and their contents are roughly similar. *Nature*, too, has had to contend with high costs of printing—perhaps higher than in this country. To meet these costs the annual subscription price for *Nature* has been increased to 4 pounds, 10 shillings, which is equivalent to a little more than $18 in American money at present rates of exchange. In comparison with this subscription rate the membership dues of $6.50 in the Association, including subscriptions for *Science* or *The Scientific Monthly*, are moderate indeed.

From the business point of view the publication of the Association's journals is a substantial undertaking. Each week more than 25,000 copies of *Science* are mailed out, or nearly 2.5 tons of paper. Each month 16,000 copies of *The Scientific Monthly* are mailed to members and nonmember subscribers, or about 3.25 tons of paper. The total for both journals per year is approximately 167 tons of paper. The cost of paper, printing, and mailing next year will be around $140,000, or more than $500 each working day.

In explaining in some detail the magnitude and cost of printing *Science* and *The Scientific Monthly*, partly because they are simplest and easiest understood, undue emphasis has been placed upon this part of the Association's activities. In the first place, the journals must be edited and advertisements must be secured and made ready for printing. The Association also publishes technical symposium volumes, which are edited, advertised, sold, and mailed by the office staff. The accounting force must keep accurate, classified records of all receipts and disbursements, however small the items. The billings to members and advertisers exceed 40,000 pieces of mail.

It might be inferred from the fact that it has become necessary to increase membership dues by $1.50 per year that the future of the Association is uncertain. Such a conclusion would be quite contrary to the opinion of its officers. Since 1938, the last year before the war broke out in Europe, the membership of the Association has increased from 19,000 to 33,000, and the rate of increase now is much greater than it has ever been in the past.

In this same period the following results were accomplished: (a) The symposium volumes comprising a total of about 4,000 quarto pages, were established, edited, advertised, and sold from the Association's offices, and more than $83,000 was received from their sale. (b) The AAAS-Gibson Island Research Conferences (now Chemical Research Conferences) were established by Dr. Neil E. Gordon and financed by contributions of $1,000 each from 33 industrial laboratories. In the interval since their founding, 79 five-day research conferences have been held, with a total attendance of about 4,000 scientists. (c) In 1945 members of the Association, in response to a circular letter from the administrative offices, contributed about $95,000 toward carrying out a somewhat nebulous plan for a permanent home. Most of this sum was applied, in 1946, toward the purchase of the square facing Scott Circle. (d) The cumulative balance from operations of the administrative offices in the 9 years since 1938 has amounted to $196,000, of which about $96,000 has been applied toward the payment for *Science* and *The Scientific Monthly* under the contract with Dr. J. McKeen Cattell for their purchase, and about $80,000 to complete the purchase of the entire square on which the offices of the Association are now located. (e) Since the close of the war the Association has purchased a considerable amount of much-needed office equipment and is now well supplied for efficient operations.

Although the costs of operations are at present distressingly high, the over-all picture for the Association is most encouraging. Where else in the whole world is there an organization having as great an opportunity to advance science as has the AAAS?

F. R. MOULTON
Administrative Secretary

NEWS *and Notes*

Earlham College, Richmond, Indiana, celebrated its 100th anniversary September 19–23 with a varied program of events in which scientists played an outstanding part. On the evening of September 19 Wendell M. Stanley, of the Rockefeller Institute for Medical Research, Nobel Prize winner and Earlham alumnus, presented an illustrated address on "Studies on Purified Influenza Virus," and the forenoon session September 20 consisted of three addresses: "What Is the Scientific Method?" by Charles F. Kettering, General Motors Corporation; "Science as a Force for Peace" by Dr. Stanley; and "Psychological and Medical Research in Aviation" by Walter R. Miles, professor of psychology, Yale University School of Medicine, who is also an Earlham alumnus. The latter part of the celebration centered around the founding of the College and a conference on "The Place of Religion in the Reconstruction of Civilization." Addresses on "Earlham in England" and "Earlham in America" were given, respectively, by Frank Woods, the Vicar of Huddersfield, England, and a member of the Gurney family of Earlham Hall, for which Earlham College was named, and by President Jones. Other invited speakers included Robert M. Hutchins, chancellor of the University of Chicago, Rufus M. Jones, emeritus professor of philosophy, Haverford College; and Walter D. Fuller, president, Curtis Publishing Company.

From the celebration emerged some interesting facts about this Quaker College's first 100 years: Of all the coeducational colleges in the country, in 1940 Earlham ranked first in percentage of living graduates listed in *Who's who in America*; in addition, Earlham men listed in the 1944 edition of *American men of science* were five times the national average of all colleges and universities on a total enrollment basis; over a 9-year period covered by a recent survey made by the Association of American Medical Colleges no graduate of the College had failed in first-year medicine; and finally, of the some 10 Nobel Prizes awarded to Americans in the field of science, two were received by former students at Earlham—Wendell M. Stanley and Harold C. Urey.

About People

C. W. Brabender, electrical engineer and physicist, and a well-known designer of testing equipment used by food processors, and **A. W. Fornet,** formerly consultant to the Royal Baking Powder Company, Berlin, and European expert on grain, flour, and breadmaking, are the first foreign scientists to be assigned to the Quartermaster Food and Container Institute for the Armed Forces, Chicago.

James H. Bywaters, U. S. Department of Agriculture Poultry Research Laboratory, East Lansing, Michigan, has been appointed research poultryman, Virginia Agricultural Experiment Station, Blacksburg, Virginia. Dr. Bywaters will plan and conduct poultry research projects aimed toward development and guidance of the poultry industry in Virginia.

Alan Gregg, director, The Medical Sciences, Rockefeller Foundation, New York City, and **Karl M. Bowman,** Langley Porter Clinic, San Francisco, have been appointed members of the National Advisory Mental Health Council, U. S. Public Health Service, succeeding **Frank F. Tallman,** commissioner of mental hygiene, Department of Public Welfare, Columbus, Ohio, and **George S. Stevenson,** medical director, National Committee for Mental Hygiene, New York City, who were both appointed consultants in mental health to the U. S. Public Health Service upon the expiration of their terms on the Council.

Tibor Rado, chairman, Department of Mathematics, Ohio State University, is on leave of absence during the autumn term to serve as visiting professor at the University of Puerto Rico.

Stuart Mudd, School of Medicine, University of Pennsylvania, was elected as the American Delegate of the Executive Committee of the International Union of Biological Sciences at its 11th General Assembly held on July 28 at the Royal Danish Academy of Science, Copenhagen.

Arthur R. Colmer, until recently of West Virginia University, is now associate professor of bacteriology, Louisiana State University, Baton Rouge.

Robert A. Conover, Department of Botany, University of Illinois, has been appointed associate pathologist, University of Florida Subtropical Experiment Station, Homestead, Florida.

Stanley W. Oexemann, Carleton College, has been named professor of biology, Carthage College, Carthage, Illinois.

William H. Summerson, formerly associate professor of biochemistry, Cornell University Medical College, is now chief, Biochemistry Section, Medical Division, Army Chemical Center, Maryland.

Emmet F. Hitch, special assistant to the management, E. I. du Pont de Nemours & Company's Chambers Works, Deepwater Point, New Jersey, has resigned after 29 years of service to become professor, Department of Chemistry, Purdue University.

Robert Kriss Wyant, formerly of the U. S. Geological Survey, Albuquerque, New Mexico, has been appointed assistant curator of Economic Geology, Chicago Natural History Museum.

William H. Hollis, research associate and instructor of industrial accident prevention, Center for Safety Education, New York University and Stevens Institute of Technology, has been appointed senior safety engineer, Los Alamos Scientific Laboratory, where he will continue basic research in accident causation and in industrial safety education program development.

Karl Lehmann, professor of fine arts and director, Archaeological Research Fund, New York University, who has been directing the salvaging of monuments in Greece this summer (*Science*, June 20), recently returned to this country after arranging for the continuation of the University's archaeological research and excavation work, interrupted by World War II, on the island of Samothrace.

Adrien Albert, who has been conducting work on the physics and chemistry of drug action at the University of Sydney since 1938, has been appointed to the staff of the Wellcome Research Institution, London, to initiate similar studies there.

Arthur G. Vestal, who has been on sabbatical leave from the Department of Botany, University of Illinois, during the past year to conduct ecological studies of the grasslands of California, has returned to the campus.

Myron Gordon, geneticist, New York Aquarium, New York Zoological Society, and **Caryl P. Haskins,** director, Haskins Laboratories, have been appointed research associates, Department of Animal Behavior, American Museum of Natural History. Together with **T. C. Schneirla** and **L. R. Aronson,** curatorial members of the Department, they form the nucleus of a group which is directing its attention toward studying factors underlying species behavior patterns in relation to problems of genetics and evolution.

Dexter H. Reynolds, group leader in charge of the Physical Laboratories, Central Research Division, Monsanto Chemical Company, Dayton, Ohio, has been appointed research professor and technical director, Division of Research and Development, University of New Mexico. Dr. Reynolds assumed his new duties September 1.

Grants and Awards

The Worcester Foundation for Experimental Biology has, during the fiscal year ending May 31, 1947, been the beneficiary of research grants totaling approximately $100,000, according to a report submitted by Hudson Hoagland and Gregory Pincus, co-directors. Donors of the grants included the Applied Research Foundation, San Antonio, Texas; the Donner Foundation; the American Cancer Society, Massachusetts Division; the G. D. Searle Company; the Committee on Endocrinology, National Research Council; the Council on Pharmacy and Chemistry, American Medical Association; the American Academy of Arts and Sciences; the Schering Corporation; and the U. S. Navy. Since July 1 the Foundation has received grants of $9,236 from the Cancer Committee of the U. S. Public Health Service and $30,469 from the Committee on Problems of Aging of the U. S. Public Health Service.

The Foundation is a nonprofit educational and research institution engaged in basic biological investigations. Part of its income is derived from annual contributions of Worcester citizens and institutions who subscribe to memberships. The Foundation's 450 members contribute approximately $25,000 per year toward overhead. To quote Drs. Hoagland and Pincus, "this community aid for basic science, given in the same spirit that characterizes its support of music, art, and other civic institutions, is most unusual and worthy of note."

The New York Academy of Sciences has received grants totaling $10,000 from the Anna Fuller Fund, Jane Coffin Childs Memorial Fund for Medical Research, NRC Committee on Growth acting for the American Cancer Society, and National Advisory Cancer Council of the National Cancer Institute, for purposes of aiding the Academy in publishing the book, *The biology of melanomas*. This will contain 27 papers, most of which were read at the Academy's conference on "The Biology of Normal and Atypical Pigment Cell Growth," held at the American Museum of Natural History, November 15–16, 1946. Myron Gordon, geneticist, New York Aquarium, New York Zoological Society, and organizer of the pigment cell conference, is consultant editor of the volume. Publication is expected this year. The New York Academy's editor is Roy W. Miner, and its executive secretary is Mrs. Eunice Thomas Miner.

Industrial Laboratories

The Eastman Kodak Company has announced a new method of making silver nitrate crystals for use in photographic manufacturing. The former method of production of the crystals by evaporation in open porcelain dishes is now replaced by a system using machinery that makes the crystals continuously and dries them in a few minutes. The drying process alone used to take several days. Chunks of silver, the material which makes modern photography possible, are dissolved in nitric acid and the resulting greenish liquid goes into storage tanks from which it is slowly pumped into 1,000-gallon stainless-steel crystallizers. Here the liquid undergoes constant stirring and addition of fresh silver nitrate solution, which makes for formation and growth of crystals in the lower part of the tank. After being drawn from the tank through a pipe, poured into perforated steel baskets, and relieved of most of their moisture by a spinning of the baskets, the crystals are redissolved in distilled water and the crystallizing process repeated. A rotary drying drum is finally used for completely drying the crystals.

Irving I. Rusoff, formerly head of nutrition, Fleischmann Laboratories, Standard Brands, Inc., has been appointed section head, Organic Research Laboratory, Central Laboratories, General Foods Corporation.

Meetings

The William James Lectures on Psychology will be given this year at Harvard University by B. F. Skinner, Indiana University, on the topic "Verbal Behavior." Dr. Skinner will speak at 4:15 P.M. on Fridays as follows: October 10, "The Age of Words"; October 17, "Verbal Behavior as a Scientific Subject Matter"; October 24, "Types of Verbal Behavior"; October 31, "Words and Things: The Problem of Reference"; November 7, "Multiple Sources of Verbal Strength"; November 14, "Making Sentences"; November 21, "The Effect Upon the Listener"; November 28, "Understanding: Real and Spurious"; December 5, "Thinking in Words"; and December 12, "The Place of Verbal Behavior in Human Affairs."

The Electronic Components Subcommittee, Aircraft Radio and Electronics Committee, Aeronautical Board, is sponsoring a technical symposium on "Printed Circuits" to be held at the Interior Department Auditorium, 18th and C Streets, N. W., Washington, D. C., October 15, beginning at 9:30 A. M. Eleven technical papers will be presented under the direction of Cledo Brunetti, National Bureau of Standards. Speakers will be included from the Army Air Forces; Navy Bureau of Aeronautics; National Bureau of Standards; Centralab Division, Globe-Union, Inc.; E. I. du Pont de Nemours & Company, Inc.; International Resistance Company; Continental Carbon Company; Signal Corps Engineering Laboratories; Remington Arms Company; Corning Glass Works; Metaplast Company; Altair Machinery Corporation; and Spraywire Laboratories, Inc. The Aeronautical Board is issuing invitations, a limited number of which are still available upon request to Printed Circuits Symposium Committee, Navy Department, Room 1W91, Washington 25, D. C.

A technical symposium on the National Bureau of Standards Casting Resin, developed by the Bureau for potting high-frequency radio equipment, will be held in the conference room of the Bureau's Materials Testing Laboratory, Washington, D. C., October 16, beginning at 9:30 A.M. The symposium is open to interested representatives of industry and government. The casting resin, primarily designed for potting high-impedance, high-frequency electronic equipment, affords ruggedness, moisture-proofing, and circuit stability. The speakers will include Harry Diamond, chief, Ordnance Development Division, in which the resin was developed, and P. J. Franklin and M. Weinberg, who were active in its formulation. An open discussion of the subject will follow the addresses.

All registrants for the Pacific Industrial Conferences, running concurrently with the 1947 Pacific Chemical Exposition, October 21–25, San Francisco, are invited to attend the programs presented by the participating groups, including the California Section, American Institute of Chemical Engineers; American Society for Testing Materials; American Institute of Mining and Metallurgical Engineers; Golden Gate Paint and Varnish Production Club; Northern California Rubber Group; Pacific Insecticide Institute; Institute of Food Technologists; Western Chemical Market Research Group; Analytical Group, California Section, American Chemical Society; Petroleum Group, California Section, American Chemical Society. R. D. Stewart, University of California, is program coordinator for the Conferences.

The American Anthropological Association will hold its annual meeting in Albuquerque, New Mexico, December 28–31, inclusive, with the University of New Mexico as host institution. An invitation has been extended to the Society for American Archaeology to meet jointly with the Association at that time.

The question of soil surveys in the Caribbean was considered at some length during the second session of the West Indies Conference, which met in St. Thomas, Virgin Islands, in February-March 1946. At that time it was recommended to the Caribbean Commission that, because of the limited number of qualified soil scientists in that area, an informal meeting of soil scientists nominated by the governments of the Caribbean territories and those of the U. S. Department of Agriculture be called at an early date. Following upon this recommendation the Commission appointed a subcommittee consisting of H. J. Page (chairman), principal, Imperial College of Tropical Agriculture, Trinidad; D. Blanche, acting head, Agricultural Service, Martinique; J. A. Bonnet, head, Soils Department, Agricultural Experiment Station, University of Puerto Rico; F. Hardy, professor of chemistry and soil science, Imperial College of Tropical Agriculture; and H. J. Muller, agricultural chemist, Department of Agricultural Economics, Surinam. This subcommittee, which met in Trinidad March 15–18, 1947, recommended in turn that a Conference of Soil Scientists be held in Puerto Rico in 1948, under the auspices of the Committee on Agriculture, Nutrition, Fisheries, and Forestry of the Caribbean Research Council. The proposed agenda includes: (1) presentation and discussion of collected data on soil-forming factors of the various territories; (2) standardization of field and laboratory methods of soil surveys; (3) discussion of different systems of soil classification and mapping; (4) formulation of a detailed regional program of surveys; (5) survey of problems of soil erosion, conservation, and renovation; and (6) practical application of soil surveys to land utilization. It is intended that the proposed conference be as representative as possible. The working committee which is preparing for the Conference has not yet settled upon a definite date.

"Earth Sciences From the Oceanographic Point of View" was the general topic of discussion at the second session of the New England branch of the American Geophysical Union, held at the Marine Biological Laboratory, Woods Hole, September 18, under the chairmanship of C. O'D. Iselin. Highlight of the meeting was Maurice Ewing's talk on the recently concluded expedition of the *Atlantis* to the mid-Atlantic Ridge (*Science*, July 18), during which considerable quantities of rock from the steep slopes of the Ridge were obtained for examination and classification. A paper by Reverend Daniel Linehan, of Weston College, Massachusetts, described the tripartite system of recording the direction and location of a hurricane through three U. S. Government seismic stations set up in the West Indies. W. D. Urry, Carnegie Institution of Washington, described a method whereby the age of sediments on the ocean bottom may be determined by analysis of their radium content. Prediction of average monthly conditions under which Navy landing craft and seaplanes can safely be operated near beaches is made possible by an instrument described by H. R. Seiwell. J. B. Hersey and Hilary B. Moore, Woods Hole Oceanographic Institution, discussed the question of whether shrimps or fish cause an unusual recording on ships' sonic sounding instruments. E. E. Watson, also of the Institution, described the bathyclinograph, by which a vertical current profile may be obtained. Henry Stommel and J. L. Worzel, both of the Institution, discussed, respectively, a theoretical study of large-scale ocean currents which demonstrates that discrepancies between the facts that great ocean currents are primarily driven by the force of permanent wind systems and that these currents are not most intense where wind is present are a logical outcome of influence of the earth's rotation, and gravity observations made at sea.

The Symposium on the Use of Isotopes in Biology and Medicine held at the University of Wisconsin September 10–13 brought together over 500 leaders in many branches of science, including some 20 foreign scientists—the largest scientific gathering ever devoted to the exchange of information about isotopes. The papers presented at the symposium, which were oriented toward the use of isotopes as a laboratory tool in a variety of fields including medicine, biochemistry, chemistry, physics, bacteriology, genetics, botany, and cancer research, will be published in monograph form within a few months.

Recent Deaths

William C. Anderson, 83, dean emeritus, Brooklyn College of Pharmacy, Long Island University, died in Keyport, New Jersey, September 3.

Neil A. Miner, 49, professor of geology at Cornell College, Mount Vernon, Iowa, died September 16 following an illness of several months. Dr. Miner was known for his work on Pleistocene geology and sedimentation. He was founder and director of Camp Norton, Wind River, Wyoming, for summer instruction in field geology.

William Seaman Bainbridge, 70, professor of operative gynecology, New York Post-Graduate Hospital and School, professor of surgery, New York Polyclinic Medical School and Hospital, and surgeon and secretary, Research Committee, New York Skin and Cancer Hospital, died September 22 at Danbury Hospital, Connecticut.

Pierre Lecomte du Noüy, 64, at one time chief, Division of Molecular Biophysics, Pasteur Institute, died September 22 in Roosevelt Hospital, New York. Dr. du Noüy, a former associate member, Rockefeller Institute, was the author of *Human destiny*, published in February.

Benjamin Carpenter, Jr., 51, associate professor of physics, Navy Pier branch, University of Illinois, died September 24 of a heart attack shortly after attending a noon class.

Synthetic star sapphires and rubies, made by the Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, were shown for the first time at the American Museum of Natural History, New York City, on September 24. F. H. Pough, curator of Physical Geology and Mineralogy at the Museum, indicated that these can be distinguished from the natural star stones by the curving lines which appear on the backs of synthetic stones, which may be detected by jewelers with no great difficulty. It is not anticipated that the new synthetic stones will have any deleterious effect upon the fine star stone market, even though synthetic rubies require the eye of an expert for distinction. Because each is individually processed and it is difficult to achieve uniformity in production, the synthetic stones will vary in quality, and it will be as hard to match them as to match natural stones.

The Istituto Italiano di Idrobiologia, Pallanza, Italy, founded in 1933 with private endowment and located on the north shore of the Lago Maggiore, has announced that it has space available for foreign guests. There is also a branch at Varenna, on the east shore of Lago di Como. The main activities at the Institute are in the fields of fresh-water ecology, systematics, planktology, genetics (especially *Drosophila*), and evolution. It publishes a series of *Memorie*, the third and fourth volumes of which are to appear shortly, and it is desired to arrange exchanges between these and journals or proceedings of American societies and laboratories. The Institute's equipment for field and laboratory work provides ample facilities for limnological investigations on both the great and the smaller lakes of the Alpine region. The equipment of the genetic laboratories is particularly suitable for studies on population genetics and on biophysical problems. The Institute offers free lodging and laboratory space to foreign guests, up to a maximum of five at a time. For further information, applications, and arrangements, those interested should contact Dr. E. Baldi, director, Istituto Italiano di Idrobiologia, Pallanza (provincia Novara), Italy.

The Society for the Study of Evolution has recently published the first issue (Vol. I, Nos. 1–2, March–June 1947) of *Evolution*, a quarterly "international journal of organic evolution" which is under the editorship of Ernst Mayr, The American Museum of Natural History, New York City 24. Assisting Dr. Mayr is a group of associate editors including C. Epling, Los Angeles; J. B. S. Haldane, London; J. Huxley, London; G. L. Jepsen, Princeton; A. Müntzing, Lund; T. S. Westoll, Aberdeen; R. W. Chaney, Berkeley; C. D. Darlington, London; R. A. Fisher, Cambridge, England; C. Hubbs, La Jolla; N. Newell, New York; J. Piveteau, Paris; Th. Dobzhansky, New York; N. P. Dubinin, Moscow; B. Rensch, Münster; A. S. Romer, Cambridge, Massachusetts; G. L. Stebbins, Berkeley; and W. B. Turrill, Kew, England. Subscriptions to the journal ($6.00 per volume) may be ordered through the business manager, K. P. Schmidt, Chicago Natural History Museum, Chicago 5, Illinois. This journal, designed to meet the acute need for a publication devoted exclusively to results of research in the field of evolution, will bring together contributions from all fields of biology.

The Library of the Botanical Garden and Institute and the Cryptogamical Laboratory, center of studies on fungicides, human and comparative mycopathology, and mushroom culture, Pavia, Italy, wishes to exchange biological and general scientific periodicals and reprints with U. S. organizations and institutions. Almost complete series of *Atti* (Transactions; 43 vols. from 1888 on) and *Archivio Botanico* (22 vols. from 1925 on) are available as well as reprints of the same periodicals and of *Mycopathologia* and *Il Farmaco*. Communications may be addressed to the director, R. Ciferri, P. O. Box 165, Pavia, Italy.

The excellent technical library, Teknillinen Korkeeoulu, Institute of Technology, Helsinki, Finland, was bombed and totally destroyed during the recent war, according to a report from Arthur E. Morgan, Community Service, Inc., Yellow Springs, Ohio, who was a recent visitor there for the American Friends Service Committee. Martti Levon, director of the Institute, will welcome gifts of scientific and technical books and periodicals from this country to take the place of those destroyed. Any such gifts should be marked for the Institute of Technology, Helsinki, and sent to the Legation of Finland, 2144 Wyoming Avenue, N. E., Washington, D. C. J. T. Jutila, Finnish Minister, will arrange for their shipment.

Make Plans for—

The New York Academy of Medicine, 20th Graduate Fortnight, October 6–17, 2 East 103rd Street, New York City.

Electrochemical Society, Fall Convention, October 15–18, Boston.

American Chemical Society, Philadelphia Section, Fall Meeting, October 16, Franklin Institute, Philadelphia.

National Conference on Industrial Hydraulics, Third Annual Meeting, October 16–17, Hotel Continental, Chicago.

Society of Rheology, October 30–31, New York City.

American Institute of Electrical Engineers, Midwest General Meeting, November 3–7, Chicago.

American Institute of Chemical Engineers, November 9–11, Detroit, Michigan.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS

by Readers

Taxonomists and zoologists whose work requires close attention to the scientific names of animals are frequently confronted with names that were badly formed when first proposed or that appear to be spelled erroneously in one way or another. Even more common are inadvertent errors and intentional emendations when names are cited subsequently to the original proposal. If only a few animals were named, these orthographic deviations would be of small consequence. The names could be emended to correspond with the best classical orthography (for the names must be Latin or latinized), and all would be well. But since there are many hundreds of thousands of named animals, the situation is not so simple. Obviously, each genus or species of animal can have only one valid name spelled in only one way, and no two may have the same name. Hence, since many names are inevitably very similar, great confusion can result if each author is free to spell any name in the way that pleases him most. Purely inadvertent errors in subsequent citations can likewise cause confusion.

Under Article 19 of the International Rules of Zoological Nomenclature the original orthography of a name is to be preserved, except that emendations may be made under certain restricted circumstances. Unfortunately, Article 19 is somewhat ambiguous as to what these circumstances are, and it likewise fails to cover fully the status of emendations and subsequent erroneous spellings. This ambiguous and incomplete coverage has led to widely varying practices among taxonomists and to considerable confusion.

In view of these considerations the undersigned subcommittee of the Smithsonian Institution Committee on Zoological Nomenclature, composed of taxonomists of the U. S. National Museum, the Bureau of Entomology and Plant Quarantine, the Geological Survey, and the Fish and Wildlife Service, gave many hours to considering the problem and has proposed the following suggestions for the rewording of Articles 19 and 20 of the present Code.

The full Committee approved the new interpretations and directed the subcommittee to publish them for consideration and discussion by zoologists. If substantial agreement can be reached, it may be in order to transmit the suggested articles to the International Commission for submission to the International Congress of Zoology, the only body with power to amend the Code, which will meet for the first time since 1935 at Paris during July 1948.

Discussion and constructive criticism by letter or publication would be welcomed by the Committee. The wording of these proposals, which are intended to bring together in a coherent and logical whole the present Articles and the pertinent Opinions of the International Commission, as well as one new corollary principle, has been very carefully studied in an attempt to cover in principle all contingencies. It is to be taken literally and strictly. The words "error" and "emendation" are defined in paragraph II.

Article 19. I. The original orthography of a name is to be preserved unless it can be demonstrated from the original publication itself that there has occurred a *lapsus calami*, a printer's error, or an error of transcription. Incorrect transliteration and misuse of connective letters are not errors in this sense. [See Opinions 8, 26, 36, 60, and 70. (Opinions 41, 61, and 63 appear to us to be inconsistent with the rest of the Rules and Opinions. We are unable to correlate them with the principles outlined above.)]

(a) When demonstrable from the original publication, such errors in original spelling are correctable and are to be treated as if corrected wherever they occur; the corrected spellings are justified emendations and take the place of the original (erroneous) spellings in all respects, including date and authorship. The erroneous spellings have no separate status in nomenclature, do not preoccupy, are not available as replacement names, and never acquire validity by citation in synonymy. [See Opinion 26.]

(b) If an original spelling is suspected of being erroneous but cannot be so demonstrated from the original publication itself, it is not subject to change and is to be treated in all respects as a properly formed name. [See Opinion 34.]

II. In subsequent publications variant spellings may occur either through intention or misadventure. For the purpose of this section emendations are defined as changes that are originally stated to be intentional, or are demonstrably so; errors are any changes that are not emendations, including those of doubtful status which cannot be demonstrated from the original publications to be emendations.

(a) Emendations that are justified under Section I above (see Ia).

(b) Emendations that are not justified under Section I above are separately validated and are objective junior synonyms of the name in its original form; they are available as replacement names; they preoccupy any later names of the same spellings; and their author is the one who proposed them as emendations. [See Opinions 34, 120, 125, and 148 (with supplementary note).]

(c) Errors, as defined above, are correctable and are to be treated as if corrected wherever they occur. They have no separate status in nomenclature, do not preoccupy, are not available as replacement names, and never acquire validity by citation in synonymy. [See Opinion 29.]

Example: The generic name *Oxytelus* has been written erroneously as *Otytelus*, *Oxitelus*, *Oxyletus*, *Oxyteius*, *Oxyteles*, *Oxytelius*, *Oxytollus*, *Oxytetus*, and *Oyxtelus*. These are all to be corrected and have no separate status.

Example: In 1833 Germar (*Rev. Entomol.*, 1, 175) published the name *Dictyophara* (Homoptera). Among the numerous variant spellings of this name that have occurred is the *lapsus calami* *Dictyonota* of de Seabra 1930 (*Arq. Secc. Biol. Par.*, 1, 347). This *lapsus* may have been caused by association with *Dictyonota* Curtis (Hemiptera), with which insect it could not have been confused. The error is to be corrected and has no separate status in nomenclature.

Article 20. In forming names based on sources using an expanded Latin alphabet, the exact spelling of the source *as quoted* is to be preserved, including diacritic marks. (The modern expanded

Latin alphabet contains many characters unknown to the Romans. Among these are: ö, ñ, ø, č, é, ç, å, ž, and many others. These are to be used whenever appropriate. Failure to use them in the name when they are quoted in the source will produce an erroneous spelling which is to be corrected to the proper form.) Names introduced in conflict with this principle are to be corrected in accordance with Article 19, Ia. [See Opinion 27; also Opinion 8, paragraph 4, of the Discussion.]

Example: In forming a name to honor the Swedish hemipterist, Carl Stål, the å should be used instead of a, as *Stålia*, but *Stalia*, if introduced without statement of source, would be acceptable. It could be corrected to *Stålia* only if proof of an error was in the original publication. (Richard E. Blackwelder, J. Brookes Knight, and Curtis W. Sabrosky, *Washington, D. C.*)

The effects of a new class of antifilarial compounds, cyanines, on the metabolism of adult filariae and growth of bacteria have recently been described by Welch, *et al.* and by Brooker and Sweet (*Science*, May 9, pp. 486, 496). A striking similarity is obvious in the action of the cyanines and the antimalarial drug, atabrine.

Welch, *et al.* report that cyanine #348, (1-amyl-2,5-dimethyl-3-pyrrole)(1-6-dimethyl-2-quinoline) dimethinecyanine chloride, inhibited the respiratory activity of the filariae at low concentrations of the drug. This was associated with a compensatory increase in glycolysis. An analogous situation was reported in the action of atabrine in the glucose metabolism of *Plasmodium gallinaceum* (M. Silverman, *et al. J. inf. Dis.*, 1944, **75**, 212). Low concentrations of atabrine inhibited the respiratory activity of *P. gallinaceum*, with a resultant increase in glycolysis.

Brooker and Sweet reported that the growth inhibition of *Escherichia coli* by cyanine #348 was partially reversed by high concentrations of thiamine, riboflavin, nicotinic acid, and pantothenic acid but not by pyridoxine and p-aminobenzoic acid. Identical effects were obtained with these B vitamins in the growth inhibition of *E. coli* by atabrine by Silverman and Evans (*J. biol. Chem.*, 1944, **154**, 521). It was also shown that the naturally-occurring polyamines, spermine and spermidine, are active antagonists of the inhibitory effects of atabrine in the growth of *E. coli*. Both reports (Brooker and Sweet, Silverman and Evans) indicated that natural materials contain antagonists for cyanine #348 and atabrine whose activity cannot be replaced by the well-characterized B vitamins.

It seems quite possible that when the modes of action of cyanine #348 and atabrine are established, the fundamental mechanisms involved will be essentially the same. (Milton Silverman, *Division of Physiology, National Institute of Health, Bethesda, Maryland.*)

The results of determinations of the growth hormones of several species of plants, native and exotic, including trees, by M. Kramer and K. Silberschmidt have recently appeared (*Arg. Inst. Biol. Dept. Def. San. Agric.* (São Paulo), November 1946, 17, Art. 7).

Extractions were made from segments of organs and sections of cambium by contacts with agar, and measurements were made by the conventional *Avena* coleoptile bending test. Relative concentrations from leaves, inflorescences, etc. with expected gradients from regions of origin to growing tracts in stems and elsewhere were found.

Since climatic, seasonal, and geographic features were taken into account, it seems necessary to correct the erroneous assumptions that my own results, expressed as dendrographic measurements of *Salix* and *Populus*, were obtained by experiments in Washington, and that I found the behavior of the two trees parallel.

Dendrographic records of *Populus* were made of one of seven species native to the region, under regulated irrigation, through several of the long, dry, hot summers characteristic of the Tucson area. Similar observations on *Salix lasiolepis* were made from 1922 to 1935 at Carmel, California, at which place this tree is native (Carnegie Institution of Washington, Publ. 462, 1936, 152–158). The maritime climate, with equable temperatures, humidity, and unvarying soil moisture and with the implied longer growing season, forms a basis for a dendrographic record widely different from that of *Populus* in the Arizona desert. The divergent features of the hydrostatic meshwork of the two trees might be expected to cause their divergent behavior if cultivated together in a neutral region (*Amer. J. Bot.*, 1946, **33**, 318–328). (D. T. MacDougal, *R.F.D. #1, Box 170, Carmel, California.*)

Certain parts of the recent paper of Taplin and Bryan on the use of micronized therapeutic agents by inhalation (*Science*, May 9, p. 502) merit comment.

(1) Taplin and Bryan indicate that their patients prefer the inhalation of penicillin dust to penicillin aerosol. It should be called to the attention of readers of *Science* that penicillin dust having particles 1 μ in diameter, as reported by these authors, is also an aerosol. Suspension of fine, solid particles in a gas constitutes aerosols very commonly used both in industry and in medicine. For example, burning asthma powder produces an aerosol which has been known and used for many years in the therapy of asthma.

(2) The arguments advanced by Taplin and Bryan on the advantages of administering penicillin and other antibiotics as fine powders 1 μ in radius are not necessarily correct. The mass of a particle 1 μ in radius is proportional to the cube of the radius. Assuming that the particle is 100 per cent penicillin, the mass is proportional to 1.0, or equal to 1 mass unit. The writer has utilized penicillin dissolved in water containing approximately 1,000,000 units/cc. with the DeVilbiss No. 640 nebulizer. With this nebulizer most of the dose is administered in particles from 1 to 2 μ in radius (*Ann. Allergy*, 1946, **4**, 440). It is evident that particles 1 μ in radius will have approximately 60 per cent of the mass of the liquid particle as penicillin, or each particle will contain approximately 0.6 mass unit. This is somewhat, but not much, less than the solid particles of the aerosol of Taplin and Bryan. However, this difference is more than compensated by the presence of many particles reaching 2 μ in radius. The dose of penicillin in these particles is 60 per cent of $(2.0)^3$ or 4.8 mass units of penicillin per particle. This is more than four times the amount of penicillin per particle of solid penicillin in a penicillin dust having particles 1 μ in radius.

(3) The loss of penicillin dust by deposit in the mouth and upper respiratory tract is not described.

In view of (a) the simplicity of using penicillin dissolved in a liquid, (b) the availability of ordinary commercial nebulizers, and (c) the difficulty of maintaining penicillin particles without aggregation in tropical storage, it is believed that, for the present, the use of penicillin aerosols in the form of liquid droplets is to be recommended for routine procedures. (Harold A. Abramson, *The Biological Laboratory, Cold Spring Harbor, New York.*)

TECHNICAL PAPERS

DDT for Powder-Post Beetle Control in Bamboo

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Scarcity of Eastern Hemisphere bamboo resulting from the war and continued shipping difficulties has created a rising interest in bamboo produced in the Western Hemisphere. About 30 species and varieties, comprising probably the largest collection of bamboo in this part of the world, have been introduced into Puerto Rico by the Federal Experiment Station in the 45 years since its establishment in Mayaguez. A number of these species have shown themselves to be well adapted to local conditions, and culms are now available in commercial quantities in Puerto Rico or other parts of the Western Hemisphere. However, the main limiting factor here, as elsewhere, in the utilization of these species has been the infestation of the dry culms by the widely distributed bamboo powder-post beetle (*Dinoderus minutus* F.).

Although none has yet been found to be immune, systematic testing over a period of years has shown that a number of species possess considerable natural resistance to this most troublesome and damaging pest. Much of this resistance was associated with lack of starch in the wood, and, where little starch was present, resistance was correlated with low moisture content and high specific gravity (*1*). The upper part of the culm was more resistant than the lower, and usually the older the culm, the greater was its total resistance to the beetle.

The best of various artificial methods to increase beetle resistance or to prevent attack either have been too cumbersome or too hazardous or have adversely affected the character of the wood for general use. Among some of the least cumbersome that have given good results have been harvesting culms of resistant ages and allowing freshly cut, untrimmed culms to dry or cure in the field. Recently, tests of the effect of "Bakelite-forcing" were conducted in cooperation with the Puerto Rico Development Company. While this impregnation of the wood with Bakelite did not entirely close the pores of the wood or change its reaction to the iodine starch test, it did harden the wood and imparted to it other commercially desirable qualities. Under the most severe conditions of infestation, pieces so treated remained immune to the beetle, while untreated wood of the same species and age was heavily attacked.

External application of DDT is proving more practicable than the foregoing and by far more effective than any other insecticidal treatment yet tried. In tests now in progress, one thorough brushing with a kerosene solution at the 5 per cent residual strength resulted in 94 per cent control of internodal infestation in highly susceptible, freshly harvested, one-year-old culms of *Bambusa vulgaris*. After treatment these culms were held in open storage away from rain and sun for 2½ months. Under the same conditions, a saturated solution of pentachlorophenol in kerosene and a 2 per cent solution of sodium pentachlorophenate in water plus 2 per cent of wettable sulfur produced 3 and 6 per cent control, respectively. Most of the few beetle holes in the DDT-treated culms were shallow. No internal infestation had developed that could be detected without splitting, while in the check and other treatments many culms were completely riddled. Heavy crystallization of DDT persisted on most of the internodes, and no living beetles (but many dead ones) were seen about the nodes where side branches had been removed. The practically colorless DDT solution did not discolor the wood or otherwise perceptibly affect its quality.

In a previous experiment freshly harvested wood was protected from beetle attack in a naturally ventilated cage for 6 months while air-drying to a moisture content of about 16 per cent. This treatment reduced infestation more than 83 per cent, indicating, with the results from field curing, that if protection against infestation can be provided for the first several months after harvest, the wood will increase considerably in beetle resistance.

From the foregoing tests it appears that DDT will supply this early protection and any that may be needed thereafter.

Reference

1. ———, *P. R. (Mayaguez) fed. exp. Sta. Rep.*, 1944, 1945, p. 33.

Physiological Availability of Iodine in Dithymol Diiodide

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The insolubility of dithymol diiodide in water and brine and its chemical stability confer upon this compound distinct advantages over potassium iodide as an agent for iodizing salt blocks for cattle feeding. By means of radioactive iodine it has been shown that the iodine of dithymol diiodide is physiologically available to the thyroid of the albino rat.

Although a great many compounds of iodine have been tested with or without the use of radioactive iodine, there is apparently no experimental evidence that the iodine in dithymol diiodide in physiologically available. Dithymol diiodide is easy to synthesize and is commercially available. The material is sold under a number of trade names, including aristol, iodothymol, thymodin, thymol iodide, and others. Although the formula for dithymol diiodide is usually given as $(C_6H_2 \cdot CH_3 \cdot OI \cdot C_3H_7)_2$, with a molecular weight of 550.93, there is still some uncertainty as to just how the iodine is bound. In 1918 Bougault proposed a formula in which the iodine was connected directly to an aromatic carbon in place of the hypoiodite type of linkage; and the two thymol molecules were linked through the OH groups, thus explaining the stability of the compound and the suppression of the phenol function (*1*). In 1935, Leclercq, in reviewing the tests and assays for dithymol diiodide, recommended the formula of Bougault as correct (*3*). If the iodine in dithymol diiodide is bound directly to the phenolic ring, there is some similarity between the compound and thyroxine of the thyroid. Joliot has already shown that thyroxine administered to rabbits was dissociated in the body, as evidenced by the subsequent formation of diiodotyrosine and ionic iodine (*2*).

In order to determine the physiological fate of iodine in dithymol diiodide, the compound was synthesized using I^{131} obtained from the Radioactivity Center at the Massachusetts Institute of Technology. The compound was prepared and fed to albino rats as described below. Various organs were then tested for radioactivity, which was followed by means of a Geiger-Müller counter and by radioautographs. The latter method requires no special equipment, although at best, the results are only semiquantitative.

Using the method of preparation described in the Merck Index (5th ed.), radioactive dithymol diiodide was prepared from 50 mg. of potassium iodide containing 1 millicurie of I^{131}. The product which was obtained as a light red-brown precipitate was washed free of iodide ions and dried over P_2O_5.

Iodized salt for cattle blocks usually contains 0.007 per cent iodine; consequently, dithymol diiodide corresponding to this amount of iodine was thoroughly mixed with 100 mg. of tricalcium phosphate and then added to 10 grams of iodine-free salt. The tricalcium phosphate is generally used for the dispersion of iodine compounds in salt. The iodized salt was then ready for incorporation in a normal diet. A second batch of salt was prepared in which this iodine content was 100 times the normal amount. The remaining dithymol diiodide was made into a water slurry of 10 mg./ml. to be administered orally by syringe to albino rats.

The diet fed to the rats in these experiments had the following composition: corn meal, 33 per cent; oat flour, 33 per cent; skim milk powder, 25 per cent; dried brewer's yeast, 3 per cent; Mazola oil, 5 per cent; and salt (iodized with the dithymol diiodide), 1 per cent.

Diet #1 contained salt with the normal amount of iodine (0.007 per cent). Diet #2 contained salt with 100 times the normal amount of iodine (0.7 per cent). The first pair of rats were starved for 24 hours and then given diet #1. Both rats in this pair weighed 450 grams, and both ate approximately 50 grams of feed before they were sacrificed at the end of 36 hours.

A similar procedure was followed with the second pair of rats, which were fed the iodine-enriched diet #2. These rats also consumed approximately 50 grams of feed before they were sacrificed at the end of 36 hours.

A third pair of rats were fed a normal diet, but each was given by syringe three oral administrations of ½ cc. each of the suspension of dithymol diiodide in water.

At the end of the 36-hour feeding period the thyroid, kidney, spleen, and liver were removed from each rat, fixed in a 10 per cent solution of formaldehyde for 2 hours, washed in 95 per cent and in absolute alcohol, and allowed to dry. Radioautographs of all the organs were made by pressing them against an Agfa no-screen X-ray film contained in a black, lightproof envelope, the beta and gamma rays emitted by the radioactive iodine, if present, exposing the film. In such a process, a total of approximately 2,000,000 beta particles/cm.^{2} are required to "expose" the film. The results are best seen in the accompanying photographs in which the thyroids badly overexposed the films; in identical exposure times the kidney, spleen, and liver produced no exposure whatsoever.

In Fig. 1A, the radioautograph of a few minute specks of the freshly synthesized dithymol diiodide, there is evidence that the radioactive iodine had combined with the thymol, since the product had been washed thoroughly to remove all soluble iodine or iodides.

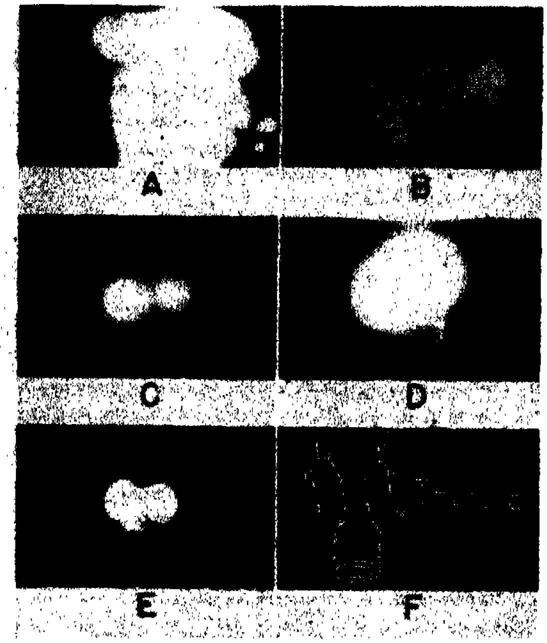

FIG. 1. Radioautographs and diagram of thyroid of albino rat: A, radioactive dithymol diiodide; B, rat diet; C, thyroid, rat #1; D, thyroid, rat #3; E, thyroid, rat #5; F, diagram thyroid, esophagus 2× actual size.

Fig. 1B shows the rat diet after the admixture of the salt containing the radioactive dithymol diiodide. The picture was taken to verify the fact that the radioactivity was evenly distributed throughout the diet by the mixing procedure used.

Fig. 1C is the radioautograph of the thyroid from one of the rats fed the diet containing the normal amount of iodine. The picture was obtained by cutting lengthwise the portion of the esophagus holding the thyroid glands and flattening the tissue against the enveloped film with a microscope slide. The radioactivity had very evidently accumulated in the thyroid.

From radioautographs of the various organs, plus those of the urine and feces, it was estimated that from 25 to 50 per cent of the iodine consumed had concentrated in the thyroid. The radioautographs shown in Fig. 1D and E were obtained in a similar manner, using the thyroids from the second and third pair of rats, which, respectively, had been fed the iodine-rich diet and had been given the dithymol diiodide slurry orally.

The fact that the thyroids of rats given the diet with 100 times the normal amount of iodine accumulated more iodine than those of the rats given much larger doses orally by syringe bears further investigation. The rats given dithymol diiodide by syringe excreted a greater percentage of the material in the feces than did the others. Some radioactivity was found in the feces as well as the urine of all the rats consuming dithymol diiodide.

The radioautographs afford graphic evidence that the iodine in the water-insoluble dithymol diiodide is physiologically available to the thyroid of the albino rat.

References

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3. Leclercq, L. *J. Pharm. Belg.*, 1935, 17, 423–428, 449–453, 467–471.

Plasma L-Methionine Levels Following Intravenous Administration in Humans[1]

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In connection with a study of amino acid metabolism in hepatic disease the observations here reported have been made on 11 normal human male subjects used as controls.

Methionine determinations were made by a microbiological method using plasma from heparinized blood. Removal of proteins from the plasma was accomplished by the following method, which avoids the use of heavy metal precipitants. To 1 volume of plasma in a 15-cc. centrifuge tube was added 1 volume of water and the tube placed for 1–2 minutes in a boiling water bath. One drop of 5 per cent acetic acid per cc. of plasma originally taken was then added and the contents of the tube thoroughly mixed, the tube remaining in the water bath for approximately 3 additional minutes. The tube was then centrifuged and a water-clear supernatant decanted for assay. The addition of tungstic acid precipitant to such a filtrate produces a very faint additional turbidity, indicating that removal of protein by the heating procedure was essentially as complete as that obtained with the tungstic acid precipitant.

Microbiological assay of the methionine in these filtrates was carried out with *Leuconostoc mesenteroides* P-60 in a medium in which an oxidized gelatin hydrolysate supplemented with tyrosine, tryptophane, and cystine served as the amino acid source. Methionine in the hydrolysate was completely removed, as evidenced by low blanks, by oxidation with 30 per cent hydrogen peroxide, using a method previously reported for the treatment of peptone (*2*). The response to added increments of methionine was equivalent to that reported for this organism by other workers.

Following a 12-hour fast a blood sample was drawn for determination of the level of plasma methionine. Fifty cc. of a 3 per cent solution of DL-methionine[2] was then injected intravenously over a 5-minute period, blood samples being drawn 15, 30, 60, 120, and 180 minutes after the injection. Methionine determinations in the urine excreted during the test period as well as during the 12 hours preceding the test were also made. In several cases urine samples to correspond to the periods when blood was drawn were also collected and analyzed.

The character of the variation in plasma methionine concentration after the intravenous injection is illustrated by the typical curve shown in Fig. 1. It is apparent that there was a sharp rise immediately following the injection which decreased to lower levels rapidly during the first 30 minutes and then much more slowly during the subsequent periods. In no case did the plasma level return to the previous fasting value in the 3-hour period of observation. In the entire series of 11 normal individuals, considerable variation in the absolute values for the various points on the curve were observed. The fasting levels ranged from 0.46 to 1.48 mg./100 cc. with an average of 0.85 ± .09. The observed "peak" value (at 15 minutes) ranged from 2.06 to 4.44 mg./100 cc., and the decrease in methionine concentration between 30 and 180 minutes varied from 0.82 to 1.36, except for a value of 2.14 in one case. Calculating the hourly rate of disappearance of methionine in the plasma from the 30- to the 180-minute period gave values ranging from 0.33 to 0.54 mg./100 cc./hour with an average of 0.41 ± .03, with the exception of the one case mentioned (not included in the average), in which a figure of 0.85 was obtained.

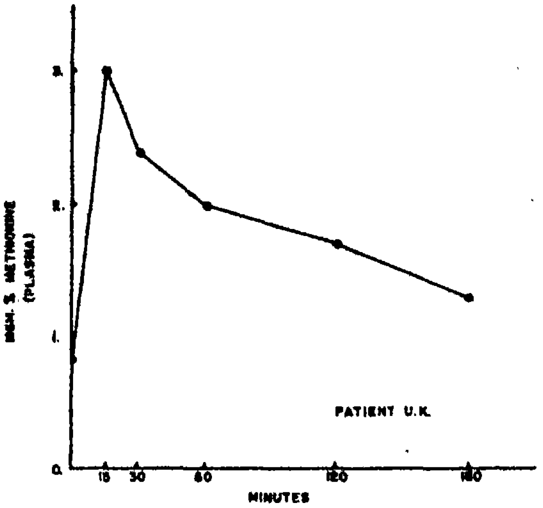

Fig. 1. Rate of disappearance of intravenously administered methionine in normal young adult.

The excretion of methionine was most rapid during the first 15–30 minutes, when the blood levels were highest, but the amount excreted at any time was quite low when compared with the original quantities administered. For the entire 3-hour postinjection period of observation only 1.6–6.5 mg. of methionine were excreted. Fasting excretion values of approximately 0.1 mg./hour were uniformly observed. Thus, it is apparent that excretion accounted for the disappearance from the plasma of only a negligible portion of the 750 mg. of the L isomer administered, and that at these plasma levels no evidence of a limiting rate of renal tubular reabsorption for methionine was observed. This is in accord with the observations on dogs reported by Wright, *et al.* (*3*).

In view of the report of Dunn, *et al.* (*1*) on the response of various lactobacilli to the isomers of methionine, these assays as carried out with *Leuconostoc mesenteroides* P-60 are interpreted as measuring only the L isomer. Further study of this problem using *Lactobacillus fermenti* 36, which responds to both isomers, is in progress.

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[1] This work has been performed under a grant from the Office of Naval Research.

[2] The DL-methionine used in these experiments was supplied by Mead Johnson Co. through the courtesy of Dr. Warren Cox.

It will be noted that a fixed test dose of methionine was employed throughout all these experiments, regardless of variation in body size, and this probably accounts in part for the variation in absolute values here reported. However, expressing the observed rate of disappearance in terms of milligrams per hour yields values which are quite comparable. Experiments with other test dosages may further clarify this point.

The rapid initial fall in plasma methionine after intravenous injection is interpreted as due mainly to diffusion into the blood cells and extravascular spaces and, to a very slight extent, to excretion. The more gradual and regular rate of disappearance apparent in the later stages would seem to be a reflection of metabolic phenomena, and hence this has been considered more significant in the interpretation of the response of various subjects to the test dose of methionine.

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Activation of Eggs by Oxidation-Reduction Indicators

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In a previous paper (*1*) the writer suggested that the mechanism of fertilization of eggs was dependent upon the production of the appropriate redox potential of the enzymes controlling oxidations in the egg.

In order to test this hypothesis further, eggs were placed in sea water containing redox dyes whose E_0' values at pH 7.0 ranged from +.195 to −.258, giving an rH from 20.5 to 5.2. These dyes included *o*-cresol indophenol, methylene blue, brilliant cresyl blue, indigo tetra-, tri-, di-, and monosulfonate, Janus green, and neutral red. The concentration of the dye varied from .002 to .0001 per cent. The marine eggs used were those of *Urechis caupo* and *Strongylocentrotus purpuratus*. Since the end of the season for these eggs prevented further experimentation, this preliminary report is made.

The freshly obtained eggs were placed in solutions of dye in sea water for various periods of time from 1 minute to 24 hours and then replaced in sea water. Crowding was avoided. Samples were taken out at intervals. Activation was observed chiefly when eggs had been exposed from 1 minute to 20 minutes in the dye solution. Activation depended at different times on temperature, time in the dye solution, and concentration of dye. By activation is meant here either the formation of a fertilization membrane or cleavage with or without the membrane. In the case of *S. purpuratus*, development progressed to the pluteus stage in from 1 to 2 per cent of the eggs, in *U. caupo*, to the trochophore stage in about 50 per cent of the eggs. In other cases only the fertilization membrane appeared, the 2-, 4-, 8- or more cell stage developed, or irregular division occurred. The maximum percentage of activation varied from 70 per cent in *Urechis* to 10 per cent in *S. purpuratus*. Toward the end of the season no activation was obtained. In all cases unfertilized controls were completely free from activated eggs, while fertilized controls showed from 90 to 100 per cent activation.

In the case of *S. purpuratus*, the best results were obtained with indigo monosulfonate, which has an rH of 8.7. The rH of the sperm of this sea urchin was found to be from 9.0 to 9.5. In the case of *Urechis*, methylene blue and indigo tetrasulfonate gave the best results. The rH values of these dyes are 14.4 and 12.[illegible], respectively, while that of the sperm of *Urechis* was found to be between 13 and 14. These results show a remarkable agreement between the rH values of the activating dyes and the respective sperms. Neutral red produced some fertilization membranes in a few cases. O-cresol and Janus green showed no results. A few cases of activation were produced by some of the dyes in the middle range of rH values. Development in all cases was slower than that of eggs fertilized by sperm, and a smaller proportion developed. These facts were also found by J. Loeb (*2*) in his experiments on artificial parthenogenesis with salt solutions. In some cases unorganized division takes place, resembling that of growth in neoplasms.

It should be pointed out that the sulfonate dyes have long been considered not to penetrate living eggs. However, since they have an activating effect on eggs in these experiments, one must conclude that either they penetrate at least far enough to produce parthenogenesis or the process of fertilization is initiated as a surface effect.

This preliminary report shows definitely that there is a direct relation between the redox potential and the fertilization of eggs. Other factors which may be involved will be discussed elsewhere.

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Irreversible Differentiation in Certain Plant Cell Lineages

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One fundamental problem in the morphogenesis of multicellular plants and animals is the mechanism which produces cellular diversity, and various theories as to the principal causes of histological differentiation have been proposed. Weismann's original idea of a progressive sorting out of nuclear determinants cannot be accepted. Nuclear changes of mutational character apparently play only a minor role, and at present there is general agreement that the locus of differentiation must be the cytoplasm itself. There is some difference of opinion among biologists as to just how this is brought about. It is characteristic of multicellular plants that they respond more directly than animals to influences from the outside; their cells, both in normal and regenerative ontogeny, preserve a high degree of totipotency, and, unless they have become very specialized or possess aged cell walls, they differentiate, dedifferentiate, and redifferentiate in relation to their position and to factors of both the internal and external environment (*3, 9*). The specific character of animal cells, on the other hand, is often determined very early, and it is maintained in nonspecific environments such as tissue cultures; if dividing, such cells may "breed true"—that is, produce only their own type. Botanists have thus come to regard the environment as a factor of major importance in many phases of histological differentiation, and much of the work has therefore been concerned with environmental modifications and effects on the cells. Zoologists, in several recent discussions, have developed a principle which might provide an understanding of the phenomenon of determination and stabilization of specific cellular differentiation in the organism. This assumes the presence in the cytoplasm of determinants genic in nature—the plasmagenes—which would account for the persistence of a particular type of cell character. It has been suggested that such plasmagenes are replicas or partial replicas of nuclear genes, nucleoprotein in nature, the activity and competition of which are subject to selection and mutational modification under the influence of variable local conditions and nuclear products. The capacity of autonomous, persisting duplication of such entities forms the basis for the transmission of specific cellular differences along cell lineages in somatic differentiation (cf. *11, 12*). Plasmagenes seem to bear close relation to viruses (cf. *6*) as to origin and chemistry, and it has been suggested that they are capable of being transmitted by grafting (*2*). Cytoplasmic inheritance is known in plants and has been demonstrated, for instance, for visible cytoplasmic constituents such as plastids (e.g. *7*), but there has been little evidence of persistence of cellular character in somatic cell lineages such as described for animals. The following observations, however, suggest that similar phenomena occur in plants which may serve as a basis for further work in this direction.

In the seedling and mature plant of *Ricinus communis* various kinds of cells (idioblasts) occur, notably those containing calcium oxalate and secretory cells whose contents give the reactions of unsaturated fats and tannins. A general survey of the distribution of both crystal and secretory cells was given by Scott (*8*). In some varieties of *Ricinus* the latter develop a natural red pigment (*1*). In the stem they are found in epidermis and ground parenchyma, especially of the pith. The writer has observed that the initials of these secretory cells are differentiated from cells of the ground tissue during early development. Their earliest appearance may be noted within the small-celled meristematic cone of the growing point itself, and they can be clearly seen at the level of the nodes of even the youngest portion of the stem. Once differentiated, they continue to divide and give rise only to secretory cells, which finally form long, vertical rows, one or several cells wide, among the ordinary cells of the ground parenchyma. In addition, new secretory cell initials are being differentiated here and there from larger and older ground parenchyma cells which develop in a manner analogous to those formed in the apical meristem. Between secretory cells in different parts of the plant some differences in the microchemical reactions were noted; in the red varieties, for example, the pigment does not appear in the youngest cells, but in those at some distance from the apex. Internodes were wounded by lateral cuts in both the youngest and fully differentiated older region of the stem, and a wound meristem was formed through cortical and pith parenchyma in which both parenchyma and secretory cells divided vigorously. The secretory cells, wherever present, produced only secretory cells. Thus, neither active cell division and growth nor altered position at the surface of the wound meristem had an effect on their anatomical and physiological character.

In other species of plants there occur various kinds of early differentiated idioblasts—for example, the so-called oil cells, tannin cells, and cells containing crystals of calcium oxalate. Cells of this kind were never observed to dedifferentiate in regenerating tissues. Some retain for a considerable time their power of multiplication; in air roots of *Cissus gongylodes*, for example, near the growing point, raphide cell initials divide several times, giving rise to rows consisting of crystal cells. Additional evidence as to the stability of cell character of the secretory cells in *Ricinus* and other similar cells might well be obtained from tissue cultures.

These observations indicate that in the differentiation of plant tissues certain cells become determined relatively early in their character and give rise subsequently to cells of the same character only, even under conditions which normally induce dedifferentiation, such as wounding and alteration of their correlative relations. The majority of plant cells do not react in this way. They remain, if they stay reactive at all, in a more or less undetermined state in which their development can be tipped one way or another under the selective control of the environment; cells can often be induced to dedifferentiate, or to differentiate in a specific fashion corresponding with their position and the particular state of reactivity which they possess at a given time and locus (*3*).

One may thus tentatively suggest that the behavior of the secretory cells in *Ricinus* involves a change in their cytoplasmic system in which control exerted by determinants in the nature of plasmagenes plays a role. The result is both a limitation of cellular totipotency and stabilization of cellular character in somatic differentiation. The cytological mechanism by which determinants of this kind come into control in definite cells is at present a matter of conjecture. It may well be that polarity plays a part. At the cell division which precedes the differentiation of a secretory cell initial, an unequal distribution of cytoplasmic material might take place, resulting in a differential concentration of determinants or determinant-precursors in the two daughter cells. Such division would be differential, though not necessarily visibly so. A number of typically differential divisions, as a result of which the two daughter cells become different in size, cytonuclear ratio, meristematic condition, and subsequently in their structure have been described previously (root hair cell, trichosclereid, and hypodermal passage cell division, *5, 10*). In each of these cases the ultimate fate of the two daughter cells is very unequal, although both cells are side by side and probably under identical environmental conditions. In *Ricinus* the capacity of cells to divide differentially obviously extends over a considerable time, since they occur both in the young and old parts of the stem and in the secondary tissue formed after wounding.

The complex patterns of structural differentiation and physiological reactivity which the observer encounters everywhere appear to be the outcome of most varied processes and forces. Some structural changes in the cells can be correlated rather directly with physicochemical factors in external and internal environment, as in the case of cells located at surfaces

(*3*). Doubtless polarity, which is basic in the elaboration of many patterns of growth and differentiation in both unicellular and multicellular forms (*4*), is another factor. It may control the orderly distribution of cytoplasmic material and various substances. Finally, as in the cells here described, there may be specific, qualitative alterations in the reactivity systems of the cells, due to permanent changes in the genetic make-up of the cytoplasm itself.

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Separate Localization in the Medulla Oblongata of the Vagal Inspiratory and Expiratory Reflex Centers

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Stimulation of the afferent vagus nerve acts upon respiration in two different ways. With low stimulus frequency corresponding to the low rate of afferent impulses elicited by lung deflation or small lung volume, the effect on respiratory posture and breathing movements is mainly inspiratory, whereas with higher stimulation rates corresponding to the higher afferent impulse frequencies produced by lung inflation or great lung volume, breathing becomes predominantly expiratory. It must be emphasized, however, that there is no hard, clear-cut line between the low-rate inspiratory effect and the high-rate expiratory effect, and that they both exist simultaneously over a wide range of intermediate frequencies. Thus, within physiological limits, a dual control of respiration is accomplished by these two antagonistic vagal tendencies, inspiratory and expiratory, the former prevailing with a decrease, and the latter with an increase, of the frequency of centripetal impulses emerging from the pulmonary stretch receptors. From this statement it may be inferred that posture as well as movement of the respiratory effector system, which is mainly or even exclusively an inspiratory one, results at any moment of the breathing act from the combined influence of the two opposite vagal drives, excitatory and inhibitory. Perhaps only in the extreme conditions of the vagus nerve artificial stimulation, with adequately chosen rates and intensities of stimuli, may pure inspiratory or expiratory effects be obtained, appearing then as inspiratory or expiratory standstill of breathing.

In order to determine whether separate reflex centers for inspiratory and expiratory effects, respectively, can be distinguished at the level of the medulla oblongata, small circumscribed lesions have been made by means of nonstimulating high-frequency coagulation, in the region of the bulbar respiratory center. It was first observed that suitable lesions situated at a more cranial level can destroy only the expiratory drive without any weakening of the inspiratory one. On the other hand, a somewhat lower, *i.e.* more caudally located lesion, abolishes only the inspiratory component of the vagal respiratory reflex, leaving the expiratory effect intact. Thus, the existence of two different central pathways involved in vagal respiratory reflexes and corresponding to the two antagonistic reflex components has been proved and has later on found further and more detailed anatomical confirmation.

Selective elimination of either the inspiratory or expiratory effect of vagal stimulation demands a small destruction lying in the tractus solitarius, its nucleus, and the adjacent dorsal part of the lateral reticular formation. For the expiratory component, this critical lesion occupies the tractus solitarius system at a more cranial level, *i.e.* just caudal to the entrance of the vagal respiratory fibers. But this expiratory lesion does not interfere with all the descending fibers of the tractus solitarius, unless the inspiratory effect be also abolished, and "central vagotomy" ensues. Some lateral portion of the solitary system, including mainly tractus fibers, must be spared, which seems to indicate that impulses mediating the inspiratory effect are conveyed in those descending fibers. For the inspiratory component of the vagal respiratory reflex, the region responsible lies in the caudal part of the tractus solitarius system, at a distance of about 2 or 3 mm. This inspiratory lesion is much less critical than the expiratory one, involving the entire transverse section of the solitary complex.

The related experimental findings lead to the following anatomical considerations: All the afferent respiratory fibers of the vagus nerve enter the medulla oblongata through the cranial portion of the vagus root and join the tractus solitarius, running down into the latter, but leaving it again at a higher level to form the expiratory and, at a lower level, the inspiratory reflex pathways. Assuming that these fibers leaving the tractus solitarius terminate mostly in its nucleus and the adjacent part of the reticular formation, where they come in synaptic contact with internuncial neurones, the column of gray matter accompanying the tractus solitarius may be considered as the locus proper of the vagal respiratory reflex centers. It is worth noting that central lesions affecting one or the other of the two antagonistic components of vagal respiratory control include besides, or perhaps rather than the tractus solitarius itself, these adjoining cellular structures. There is reason to believe that the above-described selective interruptions of the intrabulbar reflex pathways are located at those places where afferent fibers, or fiber collaterals, converge toward an interneuronic relay station, and that no selection would be obtained by the destruction of fiber tracts only. The same may be true with regard to the continuing fiber pathways, whether they be regarded as further intracentral connections of the afferent system or as the descending efferent paths of the "reflex arc." In this latter case, which appears the most likely, the selective suppression of central reflex transmission would thus be located at the origin of the internuncial neurones acting on the respiratory motoneurones of the spinal level. Definite conclusions, however, will have to be postponed until further anatomical and experimental studies have been made.

As far as our present state of knowledge permits inferences concerning the central mechanism and structural arrangement underlying the vagal respiratory reflexes, we may consider the nuclear column adjoining the tractus solitarius as the common interneurone pool for these reflexes, with a cranial part of expiratory, *i.e.* inspiratory-inhibitory, and a caudal part of inspiratory-excitatory, internuncial neurones. It is suggested that these solitary interneurones are controlling the inspiratory motoneurones directly, in an excitatory as well as in an inhibitory way. But a higher reflex integration involving the autonomous divisions of the respiratory center also exists, for it alone could account for some particular features of the vagal control of breathing.

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A New Disease of the Variegated Cutworm, *Peridroma margaritosa* (Haw.)

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In February 1947 we received from F. H. Wymore, of the Union Oil Company insectary at Anaheim, California, several diseased specimens of the variegated cutworm, *Peridroma margaritosa* (Haw.). This species was being reared in a small insectary room to obtain eggs on which ovicidal tests were being run. In the accompanying correspondence Wymore wrote that the disease had been causing an extremely heavy mortality among the older caterpillar population for a period of about four or five weeks. Only a small percentage of the caterpillars ever reached pupation, and only about 50 per cent of the eggs produced by the moths which later emerged proved fertile.

Microscopic examination of the cutworms revealed the presence of bacteria in the blood and a pathology of the fat tissues characterized by the presence of large numbers of small, granular inclusions in the cytoplasm of the fat cells. The nuclei of the fat cells were usually hypertrophied and in a state of degeneration. The bacteria, possibly secondary invaders, were gram-negative small rods which, for the most part, did not ferment lactose.

Additional diseased as well as normal caterpillars were kindly furnished by Mr. Wymore, and with this material infection experiments were conducted which provided the following information.

Healthy variegated cutworms may be infected by direct inoculation into the body cavity, and through the mouth by means of contaminated food. (There is also some evidence that the infecting agent may pass from one generation to the next through the egg.) After two or three days the infected insects begin to eat less food; they may remain slightly smaller in size than normally developing insects, have a somewhat languid appearance, and, in the cases so far observed, usually die before pupating. The fragility of the integument and the marked internal liquefaction of tissues, so characteristic of polyhedroses, is absent. The larvae are flaccid, but the body wall remains relatively firm.

Upon dissecting a diseased larva, one immediately notices an opaque whiteness of the fat tissue which may be solidly white or, in lighter infections, of the normally clear appearance except that it is flecked with opaque, white areas. Under a compound microscope these opaque areas may be seen to consist of nodules of hypertrophied fat cells filled with large numbers of minute (0.4–0.6 μ) granules. Suspended in an ordinary wet mount the infected cells break down rather rapidly, liberating the contained granules until eventually the entire preparation consists of millions of discrete granules together with some cellular debris. The granular inclusions are nearly spherical, are not as refringent as are polyhedral bodies, possess a very slight cream coloration when seen *en masse*, and are readily visible with an ordinary light microscope. When ordinary stained preparations are attempted, these bodies lose much of their distinct granular aspect and appear as lightly stained amorphous particles, frequently coalesced. They do not have the characteristic attributes of bacteria and are not cultivable on the usual bacteriological media.

Sections of the diseased cutworms show a characteristic histopathology of the fat tissue. The nuclei of the fat cells appear either as considerably enlarged, densely staining masses or as disintegrated particles of chromatin material scattered over an area which represented the originally hypertrophied nucleus. The cytoplasm of these cells is packed with large numbers of the granular inclusion bodies. Sometimes the cell membranes are broken down so that the contents of several cells are enclosed in a single area the size of several cells.

The exact nature of the granular inclusions has not been determined. Whether or not they themselves represent the causative agent, probably a virus or agglomerates of a virus, or a peculiar type of granular degeneration, is not known. A few filtration experiments have shown the filtrates from Mandler filters of coarse porosity to be infectious but, so far, not those from Mandler filters of medium or fine porosity. The granular inclusions characteristic of this disease have points of similarity with those described by Paillot (*2*) in the case of *pseudograsserie 1* of another cutworm, *Euxoa segetum* Schiff., and possibly with those briefly described by Graham (*1*) in the case of a disease of the spruce budworm, *Archips fumiferana* (Clem.). It is possible that these agents are representatives of a distinct group of virus diseases of insects, the other two groups being the well-known polyhedroses and those infections (e.g. sacbrood) characterized by the absence of inclusion bodies of any kind.

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IN THE LABORATORY

An Interval-Timing, Automatically Resetting Switch to Operate After Any Given Number of Counts

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Two commercially available pieces of apparatus were inserted into a circuit that automatically rewinds a camera every time a given number of frames is exposed, thus preventing the tension of the camera's spring-drive mechanism from becoming so low as to result in erratic performance of the shutter. The frames are counted by causing the solenoid operating the single-frame plunger on the camera to close a switch at each stroke, thereby actuating an electrically operated counter[1]. The counter is modified[2] by removing all but the first two wheels and sliding onto its shaft a brass wheel arranged to turn in unison with the second digit wheel. Two electrical contacts are made to the circumference of the brass wheel. One is a permanently closed wiping contact, and the other is interrupted by insulating segments so spaced that contact is made every 180°, or twice in each revolution of the second digit wheel, *i.e.* once every 50 counts.

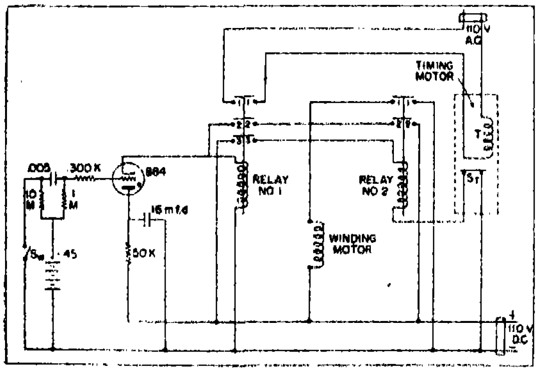

Fig. 1

On every 50th count, therefore, a second switching circuit is closed (at the point shown as S_w, Fig. 1). This simultaneously energizes the camera winding motor and a timing motor (synchronous)[3] set to cut both itself and the winding motor off after a predetermined interval (15 seconds in this case) sufficient to rewind the camera mechanism enough to restore the original spring tension in the camera drive. The synchronous timing motor has a magnetic clutch bringing the gear train of the timer into place when the motor is energized. When the clutch is demagnetized upon opening the motor circuit, a spring disengages the gear train, allowing another spring to reset the time-delay mechanism. To make the timing motor circuit independent of the duration of closure of the counter contact, which would vary with exposure rate and would remain closed if the counter were stopped on the 50th or 100th frame, the circuit from the counter is arranged so that, when closed, it produces only a short triggering pulse firing a thyratron. The output of the thyratron closes relay #1, and relay #2 is closed through contact 3 of relay #1, switch S_t in the timing motor being normally closed. Closure of contacts 2 on both relays completes a holding circuit to keep the relays closed after the pulse from the thyratron has ended. Contact 1, relay #1, starts the a-c timing motor. Contact 1, relay #2, starts the camera winding motor. After 15 seconds the timing motor opens switch S_t, which breaks the holding circuit and allows both relays to open, removing the voltages from timing and winding motors. The timing motor then resets itself, and conditions are returned to the original state.

The application described prevents the spring drive on our camera from running down enough to produce erratic performance of the shutter, which has to be maintained in synchronization with recurring single sweeps of the cathode-ray beam being photographed. Other related timing problems could be solved in this fashion by suitable small modifications of the counter and the choice of a timing motor of appropriate range.

Simplified Techniques for Inoculating Chick Embryos and a Means of Avoiding Egg White in Vaccines[1]

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Most of the current techniques for inoculating chick embryos, as, for instance, those outlined in the report by Beveridge and Burnet (*1*), involve the use of a dental drill, an instrument seldom available except in specially equipped laboratories. The techniques described below render the drill unnecessary and also have the advantage of avoiding nonspecific lesions which drilling often causes on the chorioallantois.

Chorioallantoic inoculation. The eggs are candled, and the margin of the air space is marked on the shell in pencil on the side where the chorioallantois is best developed. The shell around this area is disinfected with 1/100 Zephiran or other suitable disinfectant. Using a pair of round, pointed forceps, a hole is made in the shell over the air space, a few millimeters from its margin. The shell is jabbed with the points of the forceps until it and the attached membrane are breached, and then the hole is carefully enlarged until it is roughly 1 cm. long and 3–4 mm. wide, running parallel with the margin of the air space. Next, the shell without the attached shell membrane is broken away for 3–4 mm. beyond the margin of the air space—that is, over the chorioallantois. In doing this, care must be taken to lift the fragments of shell slowly outwards with the forceps and not to allow them to hinge back and pierce the chorioallantois. The exposed outer layer of shell membrane is then torn away, and the inner layer of shell membrane is found to have a fold about 1 mm. wide marking the margin of the air space. A fine pair of forceps is used to tear the shell membrane along this fold. Up to this stage of the operation the egg is held in the left hand in an approximately horizontal position; it is now tilted with the air space downward. With 11-day embryos the chorioallantois usually falls readily, giving an artificial air space in the same position as with the standard Burnet technique. With 12-day embryos it is usually necessary to tap the egg with the fingers to commence the separation of the chorioallantois from the shell membrane. When the separation commences, the egg is returned to a horizontal position. The inoculum is placed on the chorioallantois with a Pasteur pipette, the hole in the shell sealed with cellophane adhesive tape, and the egg incubated in a horizontal position.

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[1] Manufactured by Gorrell & Gorrell, New Jersey.

[2] We wish to thank Gracient Eidt, school machinist, for his cooperation in constructing the modified counter.

[3] Manufactured by Haydon Manufacturing Company, Connecticut.

[1] Work carried out while the author was working under a grant by the Australian National Health and Medical Research Council as a guest worker at the Pasteur Institute.

Amniotic inoculation. After preliminary incubation with the air-space end uppermost, in most of the eggs the embryo is found close to the margin of the air space, which is essential with this technique. The eggs are candled and the hole commenced as for chorioallantois inoculation, but it is not extended beyond the margin of the air space. A sharp, pointed pair of forceps is thrust through shell membrane and chorioallantois, close to the margin of the air space, and the hole thus made extended by blunt dissection to about 1 cm. As the air enters, the embryo enclosed in the amnion is presented at the hole. It may be necessary to remove some of the shell membrane adhering to the chorioallantois. Sometimes an air bubble blocks the hole; this may be disposed of by touching it with a needle heated in the flame. The amnion is grasped with forceps and inoculated with a Pasteur pipette drawn to a fine point and beveled, or with a syringe and needle. The egg is sealed with cellophane adhesive tape and returned to an upright position for incubation.

Allantoic and yolk sac inoculations. The current technique in many laboratories is to pierce the shell with a needle, and it is mentioned here merely to complete the series of techniques not requiring a dental drill. The hole is made in the shell with a surgical needle mounted by driving it through a rubber bung, after which the standard techniques are followed.

Position of the egg during incubation. Although it is well known among embryologists that the position of the egg during incubation determines the position of the embryo within the egg, this fact does not appear to be generally known by virus workers.

After 4 days incubation the embryo often moves freely within the shell, rising immediately to the uppermost point as the egg is rotated. Between the 5th and 9th days movement is slower: if an egg lying horizontal is rotated 90°, the embryo and membranes rise to the top after several hours. Between the 10th and 12th days the position of the membranes becomes fixed, but the position of the embryo may still change to some extent if the egg is turned.

If eggs incubated horizontally for 6–9 days are turned 180° so that the embryo and membranes are on the lower side, about 25 per cent die overnight. On the other hand, among eggs that are not turned at all during incubation up to the 12th day I have observed very few deaths—no more than occurred in eggs turned slightly once or twice a day.

If eggs have been incubated in the horizontal position, it is often not easy to harvest the allantoic fluid because, on reflecting the membrane under the air space, one encounters yolk sac and egg white as well as the allantoic cavity. If an egg has been incubated with the air space down, it is impossible to harvest either allantoic fluid or the yolk sac via the air space, because under the membrane in the air space there is only egg white. The embryo will be located in the "sharp" end of the egg, and the egg white is always in the lowermost point.

When cultivating influenza virus for vaccine production by red cell concentration technique, it is especially desirable to have the embryo centered under the air space. Furthermore, unless it is in this position, inoculation via a hole in the air-space end of the egg will often fail to infect the allantoic cavity.

It is of considerable importance that vaccines produced from the developing egg should be free of egg white; therefore, for the production of vaccines from allantoic fluid, yolk sac, or embryos, the eggs should be incubated before and after inoculation in a nearly vertical position with the air space upwards. They may be inclined 30°–40° from the vertical and turned by tipping back and forth once or twice a day. The only advantage in turning in this way is that it results in a more symmetrical development of the chorioallantois and allantoic cavity. On the other hand, for inoculation on the chorioallantois it is somewhat of an advantage to have a large area of chorioallantois on one side of the egg, so the eggs are better not turned before this type of inoculation. For intracerebral inoculation or amniotic inoculation by the standard Burnet technique it is better to incubate eggs in a horizontal position before inoculation.

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Use of Trisodium Phosphate With Herbarium Material and Microfossils in Peat

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A brief article recommending the use of dilute aqueous solutions of trisodium phosphate for reclaiming dried zoological specimens (*1*) suggested the possibility of using the same technique for restoring herbarium specimens to a condition for sectioning or clearing. In one test, for example, two leaves and a twig of dried *Viburnum acerifolium* L. were placed in 25 cc. of the solution and kept in an oven at 60° C. for 2 hours. The leaves assumed the external appearance of fresh material (except for a slightly less brilliant green color) and approximately the natural flexibility, toughness, and turgidity of the fresh state. Free-hand sections of the leaves showed the parenchyma cells to be in a state approximating normal turgidity and the protoplasts with a distended, although not truly lifelike, appearance. The chloroplasts of the mesophyll were distributed approximately as in the living condition. The twig also resumed its flexibility and turgidity. It was possible to cut free-hand sections of the twig with nearly the same ease as with fresh material; and the cells of the pith, wood parenchyma, and cork resembled very closely the forms of those in the living tissues.

Prolonged treatment is to be avoided; for after 18 hours at 60° C., or upon standing for several days at room temperature, certain tissues begin to show areas of brown discoloration (due presumably to the breakdown of chlorophyll and the diffusion of lignin derivatives). After 24 hours at 60° C., treated leaves become uniformly brown and begin to lose resiliency.

The success in restoring herbarium specimens led to the application of this method to the preparation of peats for analysis of microfossils. After trying concentrations which varied from 0.25 per cent to 10 per cent and temperatures ranging from 24° to 60° C., the best results again were achieved with 0.25–0.5 per cent solutions heated for 2 hours at 60° C. The peat sample is placed in a 15-cc. centrifuge tube, covered with approximately 10 times its volume of solution, and placed in the oven. If the peat has been stored in the wet condition, it can be gently broken up in the centrifuge tube with the tip of a camel's-hair brush before heating. If, however, the peat has been dried in storage, this operation is best delayed until the solution has reached 60° and has thoroughly moistened the peat. The addition of a wetting agent, e.g. Nacconol (National Aniline Company), to the solution accelerates the action on dried material. After heating, the material is twice washed with distilled water, centrifuged, and decanted. An amount of glycerine equal to the volume of the sediment is then added, and sufficient quantities are pipetted out to make slide mounts.

Although the trisodium phosphate preparation of peat samples has the disadvantage of removing very little of the materials which may tend to make the identification and counting of pollen and spores difficult, it seems desirable because it restores the sediment to a condition similar to its state when freshly deposited. The particulate matter is well deflocculated. Pollen, spores, fungal hyphae, trichomes, and most tissues of a more gross nature are re-expanded to approximately their normal shape in life. In addition to the re-expanding of the pollen grains, the exine layers appear to become turgid, so that characters such as the arcuate bands between pores of the *Alnus* grain, the hyaline bodies beneath the pore of the *Fagus* grain, and the "fingerprint" markings on the surface of the *Acer* grain stand out very clearly. The most delicate features of waxy excrescences on certain fern spores were entirely undamaged. The method causes no apparent change in the preserved diatoms, insect chitin, exoskeletons of planktonic crustacea, etc.

The study and identification of small fragments of tissues and microfossils other than pollen will prove to be of increasing significance in peat studies, particularly in contributing new lines of evidence concerning the biota and the ecological factors relating to particular strata or deposits. The use of the trisodium phosphate method is recommended as an aid in the study of this whole fossil biota of peats.

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Three-dimensional Graphs

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With respect to the construction of three-dimensional graphs (*1*), it has occurred to me that a simple procedure I have used for this purpose will be of interest. On a sheet of ordinary graph paper a base is laid out by drawing lines at angles of 45° from the horizontal. On this are plotted independent variables (x, y), while the dependent variable (z) is plotted on verticals from the base. Spaces on the graph paper serve for all three dimensions, and, if desirable, logarithmic values may be used. By connecting the points in two directions and to the base a solid figure is shown in perspective. The best effect is obtained if the graph is oriented so that the smaller values of z are in the foreground. Heavier lines should be used for the "roof" and front and right "walls" to give the correct optical appearance. For publication the graph may be copied on tracing paper and photographed.

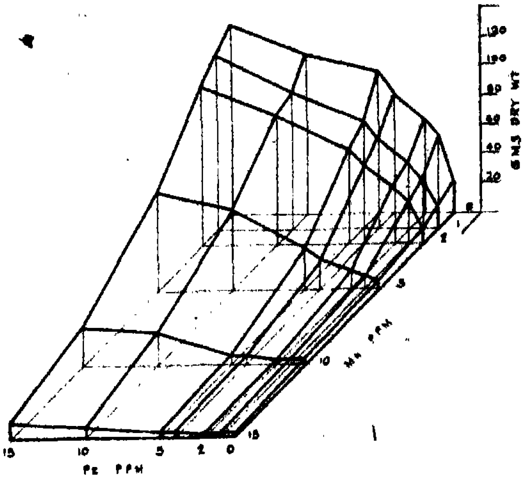

FIG. 1. Effect of simultaneous variation of manganese and iron on the total dry weight of bean plants.

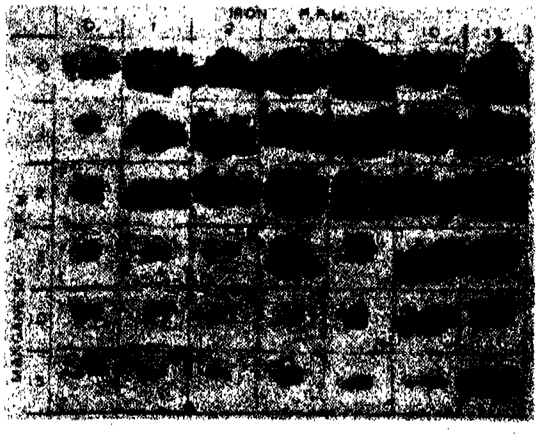

FIG. 2. Photographs of cultures of bean plants represented in Fig. 1.

On Fig. 1, which was constructed as described above, are shown the dry weights obtained by varying both the iron and the manganese concentration in a series of 42 solution cultures of bean plants (*2*), while Fig. 2 is made up of photographs of the same plants. Extreme toxicity of manganese in the absence of insufficient iron and the antidoting effect of iron are clearly shown.

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Penicillin as an Agent for Sterilization of Protozoan Cultures

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Cleveland (*1*) attempted to obtain sterile cultures of *Trichomonas* using bactericidal agents. He states that the search for efficient chemical agents for the sterilization of protozoan cultures "appears to be almost a hopeless undertaking" (p. 256). However, various chemicals have been used successfully upon protozoan cysts. Morgan's (*3*) success in obtaining sterile cultures of *Trichomonas* with the use of penicillin and streptomycin suggested the possibility of using these antibiotics as agents for the sterilization of free-living protozoa.

In the present investigation *Colpidium campylum* was used. Organisms from a wild culture were concentrated by centrifugation and were washed three times with sterile Hahnert's solution (*2*). A few drops of the washed concentrate were then added to a solution of sterile 3 per cent Difco proteose-peptone containing 5,000 units of penicillin[2]/cc. After being in the penicillin solution for 12 hours, the organisms were transferred through three successive washes of 3 per cent proteose-peptone. A drop containing organisms and culture fluid from the third wash was plated on nutrient agar. No bacterial growth was observed on any of the agar slants used in the 8 tests conducted. The colpidia were apparently uninjured by exposure for 12 hours to solutions containing 5,000 units of penicillin/cc.

It appears that this method may be used with success in obtaining sterile cultures of most protozoa. However, with each different species used, preliminary tests must be made to ascertain the length of time the organism will survive in a given concentration of penicillin. If the survival time is extremely short, lower concentrations should be used. Preliminary observations indicate that *Paramecium nucleatum* is killed in 12 hours in solutions containing 5,000 units of penicillin/cc., but remains in a vigorous condition for 5 hours in the same concentration.

The process described above does not require constant attention of the investigator, large numbers of organisms are recovered after the final wash, and the number of transfers is reduced to a minimum, thus reducing the possibility of contamination.

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[1] The author wishes to express his gratitude to C. G. Wilber for aid in the preparation of the manuscript.

[2] The penicillin used was supplied by Merck & Co., Inc.

A Monitoring Probe for Radiochemistry Laboratories[1]

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In order to detect contamination of equipment and to protect the health of workers in laboratories handling radioactive materials, it is necessary to have instruments capable of indicating small amounts of radiation at the working space and on the person and clothing of workers. Several excellent portable radiation meters are now on the market, but only the most recent ones are effective in detecting weak radiation, the older ones generally being designed for monitoring X-rays.

As Libby (*1*) points out, the isotopes emitting the least energetic radiation are among the most useful. By substituting a more sensitive GM tube for the one ordinarily furnished, older instruments easily may be changed to permit them to detect a fraction of these weak radiations large enough so that they may be of service in monitoring laboratories. Moreover, the housing for the GM tube described here permits using the tube at some distance from the meter, allowing more flexibility in monitoring and incidentally permitting any scaler to be used as a detector of contamination.

A thin-walled, silvered, self-quenching tube is mounted in a stainless-steel housing, provided with mesh-covered windows over the sensitive area of the tube. The use of stainless steel permits ready decontamination of the probe itself in case of contamination, a nitric acid wash being sufficient in most cases. Fig. 1 shows some of the constructional details of the probes used in this Laboratory. A, the body of the probe, is tubing, 10 inches long and 1 inch in diameter, which is attached to handle C by means of collar E. Tube B slides over A and can be secured in a position over the windows by tapered collar D. When not required in this position to protect the GM tube or to distinguish gamma from beta radiation, it is pushed back toward handle C. By making slide B $\frac{1}{16}$ inch thick, the original calibration (in R's/8-hour day) of a Herbach and Rademan Model GLR-200 Radiation Meter is sensibly unchanged when B covers the windows. With the slide open, the sensitivity of this meter is increased more than 10-fold for energetic radia-

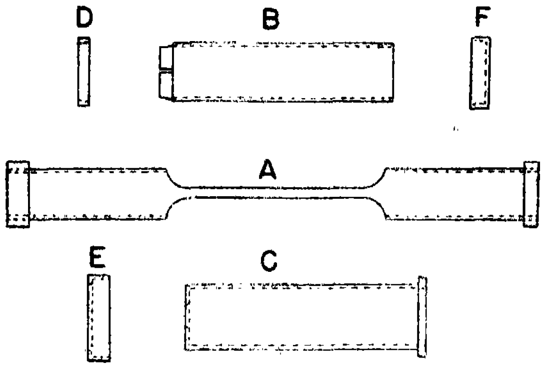

Fig. 1

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[1] Research sponsored by the Office of Naval Research, Contract N-6 ori-47, Task Order No. 4.

tion, and the detection of weak radiation is made possible. Traces of C^{14}, for example, are distinctly indicated, although weaker radiation (*1*) is not detected.

By means of a suitable connector at the end of handle C the probe is attached to the meter or scaler with co-axial cable, up to 20 feet long. In the authors' experience, the high potential supplied by an AC-operated type radiation meter requires very little change in value to enable the new tube to work on its plateau (ca. 800 volts for commercial tubes of this type).

In one application, this probe was attached to a Herbach and Rademan meter to which, in turn, had been added a simple audioamplifier and loud-speaker, obviating the necessity of looking at the meter while testing for stray radioactivity. The frequency of occurrence of the audible clicks is a measure of the intensity of the radiation passing through the probe. In another application, the described probe was attached to a standard scaler of 64, where it worked equally well.

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Use of the Hydra for Pharmacological Study

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The hydra responds to touch by a withdrawal of its tentacle from the point of contact. This process presumably involves its primitive nervous system, which consists of a simple nerve network without a central organization such as a brain. The hydra, therefore, should have possibilities as a test object for the study of certain drugs which act on nerve mechanisms. For instance, local anesthetics, which act on the peripheral portions of the nervous system, would be expected to abolish the tactile response, whereas central depressants, such as hypnotics, would not. These ideas were confirmed in the following experiments.

Individual specimens of *Hydra oligactis* were placed in glass dishes containing 5 ml. of glass-distilled water. Within 15 minutes, the hydra attached itself to the bottom of the dish. The drug to be tested was then added to the water, and changes in shape, in spontaneous movements, and in response to vigorous tactile stimulations with a glass rod were noted at 1-minute intervals.

In agreement with the above postulates, it was found that each of the three local anesthetics tested (cocaine, procaine, and pontocaine) abolished the response to tactile stimulation; and, as was expected, the general hypnotics, Dial and Evipal, failed to inhibit this reaction. The local anesthetics also frequently caused the hydra to become detached from the dish. Perhaps this was a further manifestation of peripheral nerve depression. The abolition of tactile response by the local anesthetic was not due to the death of the hydra, for it was possible to restore the sense of touch by replacing the local anesthetic solution with fresh water.

Certain quantitative relationships were also observed for the local anesthetics. The minimum effective dilutions for pontocaine, cocaine, and procaine were, respectively, 1:25,000, 1:5,000, and 1:1,000. The drugs were therefore effective in the ratio 25:5:1, which is similar to that recorded for higher animals. Table 1 shows that the time required for the onset of tactile anesthesia increased as the concentration of cocaine decreased. A similar relationship was found for procaine. These results are again comparable to those obtained on common laboratory animals.

TABLE 1

EFFECT OF VARYING CONCENTRATIONS OF COCAINE ON TIME OF ONSET OF ANESTHESIA IN THE HYDRA

Concentration (mg./ml.)	Onset of anesthesia (min.)
0.2	Partial anesthesia
0.25	20
0.4	25
0.4	30
0.4	28
0.4	37
0.4	11
0.5	3
0.5	8
1.0	2
1.0	2
1.0	11
1.0	4
2.0	Disintegration

All of the drugs mentioned produced changes in the size and shape of the hydra. The local anesthetics regularly caused an initial contraction which was soon followed by a return to the original size. The only effect of the barbiturates was to produce a persistently shortened and thickened hydra.

The actions of certain other drugs on the hydra were also observed. The analgesic, morphine, which is believed to act centrally, produced no visible effect. Curare, after an initial contraction, produced great elongation, often to two or three times the original length. A tendency to form spirals or curls was noted. There was no loss of tactile sense or of spontaneous movements. Papaverine-treated hydrae first contracted and then regained normal size, but became rigid with complete loss of spontaneous movements, of response to touch, and of response to acetylcholine. The action of the latter drug by itself was limited to an initial contraction and was difficult to assess, since many things, *i.e.* salt solutions, cold, water movement, etc., caused brief contractions of the hydra. Although these may be qualitatively similar, the possibility remains that different drugs may produce contractions differing quantitatively in extent and duration.

The hydra also appears to have interesting potentialities for the analysis of the toxic actions of certain drugs. Protoplasmic poisons such as strong cocaine solutions were quite destructive to the hydra. A series of amidines, which were known to produce necrosis in higher animals, actually disintegrated the hydra within a matter of minutes. On the other hand, drugs which exert their lethal actions in higher organisms by affecting such organizations as the respiratory center, were relatively harmless. For example, neither morphine nor the very toxic curare killed the hydra, even in high concentrations.

Book Reviews

Radioactive tracers in biology: an introduction to tracer methodology. Martin D. Kamen. New York: Academic Press, 1947. Pp. xiii + 281. (Illustrated.) $5.80.

Prof. Kamen has achieved to a remarkable degree his objectives in having *Radioactive tracers in biology* provide (1) an introduction or a review of those concepts in nuclear physics, an understanding of which is basic to the intelligent application of tracer methods in biology; (2) a presentation of a systematic and critical survey of existing tracer methods; and (3) an indication of potentialities and limitations of these methods as applied to biological problems. This small, but extremely fact-packed, guide should find a welcome place on the working bookshelves of biochemists, biophysicists, physiologists, and physicians who are interested in the application of radioactive tracers to studies in biology.

The first section, a review of nuclear physics, demands a greater amount of reader effort than do the sections relating to procedures in the production and assay of radioactive isotopes. The information about procedures for radioactive assay is given in precise detail.

For the biologist, Chapter V, "A Survey of Tracer Biology," is an extremely stimulating and informative presentation of biochemical and physical applications, including the study of intermediary metabolism and a well-presented discussion on analysis by isotope dilution methods. Under physiological applications, the author discusses permeability studies, metabolic turnover, and transport studies.

Chapters VI to X, inclusive, elaborate on the use of radioisotopes and include a thorough discussion of radioactive hydrogen (tritium)—and, incidentally, an extremely valuable table of deuterium compounds—as well as C^{11}, C^{14}, P^{32}, and S^{35}. The isotopes of secondary importance in biology are discussed in Chapters XI and XII, and the final chapter, entitled "Various Radioactive Isotopes of Importance in Biology," deals with such trace elements as manganese, iron, cobalt, copper, and zinc.

The biologist will find the study of this book of real value whether he plans to engage in utilizing radioactive isotopes or to broaden his understanding of this important technique.

The book is not without some weaknesses, stemming chiefly from an insufficient attention to radiation hazards. Although reference is made to National Bureau of Standards' Handbooks H-23 and HB-20, on "Radium Protection" and "X-Ray Protection," the reviewer believes that somewhat greater detail regarding the handling of hazards could have been incorporated in this volume. The author might also have elaborated his discussions of radiation effects in organisms and of the need for awareness of the ever-present hazards in research on metabolism with radioactive isotopes, because of the physiological effects of the radiation from the tracers.

This is apparently Volume I of a new series of monographs in Organic and Biological Chemistry under the editorship of Louis F. and Mary Fieser, to be published by the Academic Press. As such, one would hope for greater care in publication. An errata sheet listing 10 errors in a 270-page book does not speak highly of the diligence of proofreading. A certain amount of distraction, if not occasionally confusion, develops from the use of superscripts of the same type and point for designating the mass numbers and references to bibliographic footnotes.

The author has done the biologist a real service in offering this excellent work.

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Descriptive and sampling statistics. John Gray Peatman. New York: Harper, 1947. Pp. xviii + 577. (Illustrated.) $5.00.

This book recognizes the dilemma of social science students who need certain statistical knowledge and skill, but for whom the time requirement of mathematical training is either discouraging or prohibitive. In his attempt to meet the needs of this particular group, the author has made commendable use of ordinary English prose for the presentation of various statistical devices and the illustration of their uses. The text is entirely free from elaborate formulas and derivations. Its content is well supported by timely and appropriate illustrations, and excellent pedagogical value may be anticipated for the exercises at the conclusion of each chapter.

This very practical book will probably enjoy a wide demand as a text for undergraduate and first-year graduate students in education and sociology. It should provide a useful background for some kinds of research and will greatly facilitate the comprehension of those who must read the current literature in education, sociology, anthropology, and psychology.

Although the author has realized most of his expressed aims, his work is not without serious fault. The problem of nonlinear correlation receives a most summary dismissal; for example, Eta and Epsilon are ignored. The use of the important F test and the simplest illustrations of analysis of variance and covariance are omitted. A chapter on cluster and factor analysis is included, but the discussion is misleadingly inadequate. Neither the assumptions of factor analysis nor their implications are given. Spearman's two-factor theory receives one paragraph. All multiple-factor theories are lumped together in one paragraph. The rest of the chapter is concerned with a little-used, casual method of cluster analysis.

Despite the omission of certain important topics, the book has a broad scope and may create the illusion in the student that the treatment is comprehensive. This would be regrettable, because in general the assumptions underlying the development of the various statistics and governing their appropriate use are poorly defined or omitted. Equally serious is the presentation of a large group of standard-error formulas with the instruction that the statistics in question are essentially normally distributed. In the case of sample sizes commonly encountered, this assumption is questionable for some of the statistics, and for other statistics, e.g. the standard deviation, it is known to be incorrect. With few exceptions, the student is encouraged to regard his samples as large samples. These limitations are not unique to this textbook, but they are regrettable in that they may encourage a "cookbook" approach to experimental design and the testing of statistical hypotheses.

The sequence of topics is unusual, and many things which ordinarily go together are widely separated and treated in a piecemeal fashion. Although there may be good reason for this, its merit was not apparent to this reviewer.

The simplicity and rigor of modern inferential statistics, particularly for small samples, may not be discerned by the student who uses this textbook, and he will have little opportunity to be discouraged by either the mathematical or logical rigor which features many textbooks in statistics.

Nevertheless, in terms of the aims of this textbook, its positive features greatly outweigh its shortcomings.

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Scientific Book Register

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Genetic Effects of the Atomic Bombs in Hiroshima and Nagasaki

Genetics Conference, Committee on Atomic Casualties, National Research Council

The Atomic Energy Commission recently formally signified its intention of supporting long-range medical studies of the survivors of the atomic bombings in Japan, to be conducted by the Committee on Atomic Casualties of the National Research Council. One aspect of these studies will concern the much-discussed potential genetic effects of the bombs. The background of this program begins shortly after Japan's surrender, when a Joint Army-Navy Commission made extensive observations in Hiroshima and Nagasaki on the survivors of the bombings. At the conclusion of the Commission's work its chairman, Col. A. W. Oughterson, M.C., AUS, recommended to the Surgeon General of the Army that the Council be requested to undertake a long-range study of the medical and biological effects of the atomic bomb and this recommendation was transmitted by Surgeon Gen. Norman T. Kirk to Lewis H. Weed, chairman of the Division of Medical Sciences. As a result, in June 1946 a conference group was convened by the Council, and in November, following its recommendation, a five-man commission composed of representatives of the Council, the Army, and the Navy left for Japan for the purpose of determining the current status of Japanese work on atomic bomb casualties, evaluating the feasibility of American participation in continued research on these casualties, and indicating the lines along which such studies should proceed. This commission, known as the Atomic Bomb Casualty Commission and composed of Austin Brues, Paul S. Henshaw, Lt. Melvin Block, M.C., AUS, Lt. James V. Neel, M.C., AUS, and Lt. (j.g.) Frederick Ullrich, (MC) USNR, submitted a report of its findings to the Council in January 1947.

The June 1946 conference group had recommended that appropriate action be taken to obtain a Presidential Directive authorizing the National Research Council to initiate a long range study of the atomic bomb effects. This Directive was issued at the request of the Secretary of the Navy, James T. Forrestal, in November 1946, and on its authority the Council, in January 1947, established a Committee on Atomic Casualties, composed of Thomas M. Rivers (chairman), George W. Beadle, Detlev W. Bronk, Austin Brues, George M. Lyon, C. P. Rhoads, Shields Warren, Stafford L. Warren, George H. Whipple, and Raymond E. Zirkle.

The potential genetic effects of the atomic bomb were apparent to all interested students from the day the first bomb was dropped—in fact, to some, well before that time. A consideration of genetic studies was one facet of the work of the Atomic Bomb Casualty Commission, and a section of its January 1947 report was devoted to this subject. This phase of the work was to a large extent the responsibility of Lt. James V. Neel.

On June 24, 1947, the Committee on Atomic Casualties arranged a conference on the potential genetic effects of the atomic bombs. At this meeting, which was attended by George W. Beadle (chairman), Donald R. Charles, Charles H. Danforth, Herman J. Muller, Laurence H. Snyder, and Lt. Neel, the latter submitted a report of preliminary genetic studies, based on his observations in Japan during the preceding six months. Following a thorough appraisal of the problem, the conference voted to recommend to the Committee on Atomic Casualties that a program be undertaken in Japan along the lines sketched out in the Neel report. This recommendation was accepted at a meeting of the Committee on June 26, 1947. The conference also recommended that a statement be prepared, briefly summarizing the current status of the problem. This statement follows.

WHETHER THE ATOMIC BOMBS dropped on Hiroshima and Nagasaki will have detectable genetic effects on the Japanese is a question of widespread interest. The purpose of the present note is to show briefly that (1) many difficulties beset any attempt to obtain a valid answer to this question and (2) even after a long-term study, such as that outlined below, it still may not be possible to determine just how much genetic damage was done at Hiroshima and Nagasaki.

This memorandum is essentially a partial summary of the material presented by Lt. James V. Neel at the meeting of the Conference on Genetics convened by the Committee on Atomic Casualties of the National Research Council on June 24, 1947, but with certain additional considerations which grew out of the deliberations of the Conference.

It must first be recognized that, inasmuch as the majority of mutations occurring in animals are recessive, only the relatively small proportion of mutations which are dominants may be expected to show effects in the first postbomb generation. The potential range in their effects is very wide. Dominant mutations with large, clear-cut manifestations can be expected to be much rarer than those with smaller, but possibly quite significant, effects on bodily dimensions, life span, etc. But the detection of these latter is a matter of great difficulty with present techniques. For practical considerations investigation will have to be concentrated chiefly on the class with such large effects as may lead to stillbirths, to live births with gross external abnormality, or to internal defects causing death or serious illness in infancy.

Since there is no general agreement as to what proportion of cases of abnormal fetal development is genetically determined, and what proportion is due to nongenetic factors, an increased incidence of morphologically abnormal fetuses following irradiation may not be used as an index of the frequency of genetic change until the nongenetic effects of this irradiation on the reproductive history of the mother have been determined. This point will be very difficult to evaluate.

It is obvious that in this case the approach to the problem of genetic effects is the statistical one. It is unlikely that any individual and specific pathology in a post-irradiation generation can ever be attributed with certainty to the effects of the bomb, but if there is a definite increase in the occurrence of abortions, miscarriages, stillbirths, and abnormal products of conception, one may surmise that this is related to the bombing—although some of the effects need not necessarily be genetic. Appropriate control studies in other Japanese cities are therefore of the utmost importance.

The survivors of the bombing received amounts of irradiation ranging from negligible to just short of lethal. It is impossible to say on a priori grounds whether an adequate number of people absorbed sufficient radiation to produce enough dominant mutations to result in detectable effects. However, comparison of this situation with the experimental data on infrahuman material suggests that these effects, if detectable, will be small. The median lethal dose for whole body irradiation in man is probably in the neighborhood of 500 Roentgen units (Shields Warren. *Physiol. Rev.*, 1944, **24**, 225–238). It is likely that many individuals in Hiroshima and Nagasaki who received high but sublethal doses of irradiation sustained other injuries which, in combination with the radiation damage, resulted in death. Thus, the mean radiation dose received by the surviving population will be lower than expected from a consideration of the median lethal dose alone. In terms of radiation genetics this is a small exposure, expected from data on animals to produce a frequency of dominant mutations which would increase the normal frequency of abnormal offspring by so small a proportion as to be difficult to demonstrate. Large-scale studies, utilizing all available material, plus accurate vital statistics, are thus necessary if data of value are to be obtained. In this connection it is important to bear in mind that the available children born to parents who received significant amounts of irradiation will probably not exceed 12,000 or 13,000 within the next 10 years.

The Japanese had recognized the importance of genetic studies and, under great difficulties, were organizing a program in Hiroshima when the Atomic Bomb Casualty Commission arrived. They had planned to compare the present and future frequency of abnormal births in Hiroshima with the frequencies reported in their medical literature and vital statistics during the prewar years. But it is by no means sure either that the prewar figures were sufficiently accurate or that the present reporting of vital statistics would be wholly effective in detecting rare effects of the atomic bomb radiations. It cannot be too strongly emphasized that there is at present absolutely no reliable evidence on which to base any opinion concerning the absolute or relative frequency of congenital abnormalities among children being born in Hiroshima and Nagasaki. Unfortunately, a good deal of misinformation is currently in circulation.

Two independent programs, one Japanese and one American, would involve needless duplication of effort. A joint undertaking is therefore indicated. In view of the fact that the Japanese are actively attempting to initiate genetic studies, it seems that any American efforts which may materialize should contemplate cooperation with the Japanese in an attempt to ensure an efficient and satisfactory program. The Neel report contains the following seven specific recommendations as to the organization of a program:

(1) Organize, in Hiroshima, Nagasaki, and a control area or areas, a modified system of pregnancy registration, this to include the irradiation history of the parents.

(2) Obtain as complete information as possible on the outcome of each registered pregnancy.

(3) Follow up each report of an abnormal termination of pregnancy or a congenital malformation with detailed family studies.

(4) Develop a system of checking on the completeness and accuracy of registration of births and deaths, such as requiring at intervals dual registration by both the family and the obstetrician or midwife.

(5) Conduct these studies on a sufficiently large scale that the results will have statistical significance.

(6) Integrate this program with a system of periodic examination of the offspring of irradiated persons and with careful death certification, so that genetic effects not apparent at birth but detected subsequently may be recorded. In particular, causes of infant mortality should be accurately recorded.

(7) Place this program in competent Japanese hands, through the Japanese Government, with only enough American supervision and cooperation, including supplies, to facilitate a successful program.

This program must extend over a period of 10–20 years before a significant amount of data can be accumulated, and quite possibly an even longer period of study, extending to the second and subsequent generations, will be indicated.

Certain practical limitations of the program may be considered at this point. The most difficult problem will be to obtain the necessary completeness of reporting. This will require constant effort, a wide educational program, and frequent cross-checks. Congenital malformations occurring within Japanese families may sometimes not be reported. This is perhaps more likely to occur in Japan than in this country, because probably less than 10 per cent of Japanese births occur in hospitals as these are defined in the United States. To what extent stillbirths and malformations occurring outside a hospital will be recorded depends on the vigor with which the problem is pursued. It will be difficult to get evenly matched teams of investigators for bombed and control areas. Furthermore, once people living in Hiroshima and

Nagasaki learn that stillbirths and malformations may possibly be attributed to the effects of the bomb, they will probably lose some of their reluctance to report such matters, whereas this will not be the case in a control area.

Japan is now a defeated and occupied country, under severe postwar stress, whose people have a very different psychology from our own. A program such as that under consideration will proceed much more slowly there than it would in this country.

In order to reduce the possibility that a negative result of the investigation on Japanese material be interpreted by the medical and lay public as meaning that important genetic effects were not produced, it is essential that a comparable effort be expended in experimentation on other mammalian material, in which genetic effects of different kinds can much more readily be brought to light. In this way it should be possible to throw light upon the proportion of the total genetic effects produced by the radiation that would have been detectable by the methods used in the investigation on the human material, and the serious danger of misinterpretation of the latter results would be minimized.

Recognizing the difficulties briefly touched upon in the foregoing paragraphs, the Conference on Genetics voted unanimously to record the following expression of its attitude toward the genetic program: "Although there is every reason to infer that genetic effects can be produced and have been produced in man by atomic radiation, nevertheless the conference wishes to make it clear that it cannot guarantee significant results from this or any other study on the Japanese material. In contrast to laboratory data, this material is too much influenced by extraneous variables and too little adapted to disclosing genetic effects. In spite of these facts, the conference feels that this unique possibility for demonstrating genetic effects caused by atomic radiation should not be lost."

An Auditory Afterimage?

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FOR THOSE WHO LIKE TO EMPHASIZE THE similarities between our different sense modalities, the absence of auditory afterimages has been a persistent puzzle, a blank in the table of analogies which can be drawn between vision and audition. There is, of course, tinnitus—that annoying ringing in the ears that often follows exposure to deafening sounds. But tinnitus may last for hours, is often pathological in origin, and resembles "spots before the eyes" more than a true afterimage. Tinnitus excluded, therefore, the story of unrewarded searching (*1*) seems to justify the conclusion that auditory afterimages do not exist.

The error of such a conclusion can be demonstrated with the help of a pulse generator and a pair of earphones. The generator is used to produce a train of rectangular voltage pulses at a rate of about 100 pulses per second. [The rectangular pulses used in this experiment contain all harmonics of the fundamental pulse repetition frequency at approximately equal amplitude over the frequency range transmitted by the earphones (cutoff around 6,500 cps).] The earphones transduce the voltage pulses to acoustical pulses, and the listener is allowed to hear this buzzing sound at a high intensity for one or two minutes. When the earphones are removed, there is a striking change in the timbre of such familiar sounds as a handclap, a typewriter, the voice, etc. A peculiar metallic quality seems to be added to the sounds. Listeners have described the sounds as "jangly," "twangy," "like a rasping file," or "like two pieces of iron being rubbed together." The aftereffect of the pulses is transient, and in a few seconds the sounds regain their normal quality.

We have had no trouble in demonstrating this aftereffect to subjects with normal hearing. It has been experienced in reverberant and anechoic rooms, with test noises produced in the room, over a loud-speaker, or in headphones. Phonographically recorded handclaps, sibilant consonants, the sound of scraping sandpaper, and typewriter noises seem to work about as well as the original sounds themselves.

Several questions immediately suggest themselves. What characteristics of the exposure stimulus are necessary to produce the effect? What kind of test stimuli can be used? What is the quality and duration of the effect?

Exposure to intense random noise—a hissing sound—is ineffective in producing the aftereffect. Random noise interrupted at regular intervals to give a train of 150 bursts of noise per second was also a failure. Nor did a combination of 11 oscillators producing frequencies not in harmonic relation elicit the aftereffect. Very loud pure tones of low frequency may evoke the phenomenon for some listeners. A square wave elicits the aftereffect but is much less impressive than the pulses. Pulses produce

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the phenomenon even when they are modulated in frequency from about 100 to 200 pulses per second at a rate of 20 times each second or when the low-frequency components of the spectrum are filtered out of the pulses. With a pulse repetition frequency of 140 pps the aftereffect was obtained when only those component frequencies of the pulse between 3,120 and 4,000 cps were passed, and again when only the range between 4,000 and 6,600 cps was heard. When only the first 4 harmonics of the pulse—140, 280, 420, and 560 cps—were used as the exposure stimulus, the effect was not observed, and not until the first 10 harmonics were passed was a clear aftereffect obtained. It seems that the high-frequency components of the pulse are necessary for the phenomenon to occur, but it is not clear whether these frequencies are necessary because they stimulate a certain portion of the basilar membrane or because they preserve the sharp onset of the pulses.

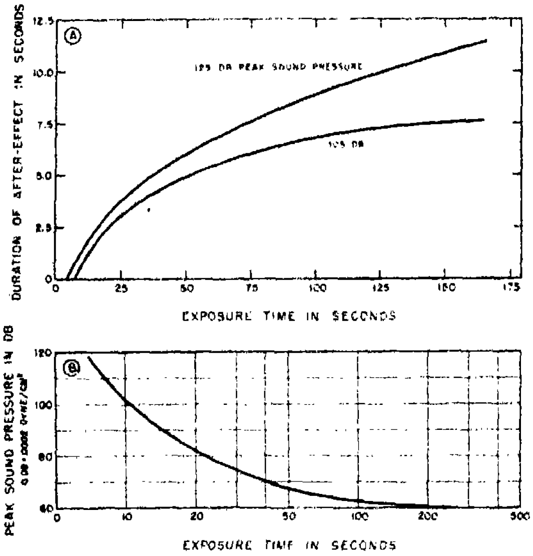

Fig. 1. A—Duration of aftereffect as a function of exposure time (parameter: peak sound pressure; pulse repetition frequency = 120). B—Peak sound pressure vs. exposure time for fixed duration of aftereffect (2 seconds) (pulse repetition frequency = 140).

The pulses used were of 120-microsecond duration, and the instantaneous sound pressure at the peak of the pulse was varied from approximately 75 to 125 db re 0.0002 dyne/cm.². For convenience in exploring the phenomenon the following procedure was adopted: The sound of two pieces of sandpaper being rubbed together at a regular rate was phonographically recorded, and the listener was exposed to the train of pulses for a fixed period of time at a given intensity and pulse repetition frequency. At the end of the exposure the experimenter switched to the phonograph channel, the listener being allowed to hear the sound of scraping sandpaper. The listener's task was then to count the number of scrapes of the sandpaper which seemed to be "metallic" in quality. By converting sandpaper rubs to a more conventional time base, the duration of the afterimage was given for the conditions of stimulation.

Durations of exposure between 5 and 240 seconds were explored, the longer exposures producing the most marked aftereffects. When the sound pressure at the peak of the pulse was held constant, the duration of the aftereffect increased as a negatively accelerated function of the exposure time. This is illustrated in Fig. 1A for two intensity levels. Fig. 1B shows the peak sound pressure necessary to elicit an aftereffect of constant duration (2 seconds). To a certain degree, exposure time can be substituted for exposure intensity. As a practical matter, an exposure of 20 or 30 seconds represents a convenient compromise between the listener's impatience and the experimenter's desire to produce a measurable effect

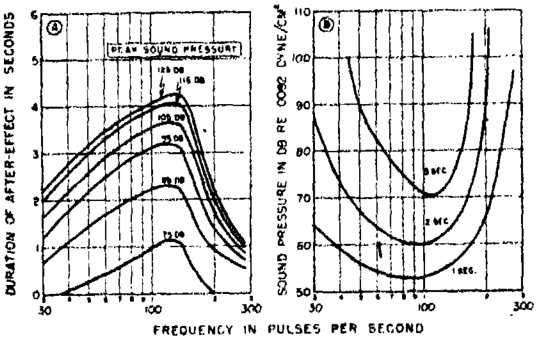

Fig. 2. A—Duration of aftereffect vs. pulse repetition frequency (parameter: peak sound pressure; exposure time = 20 seconds). B—Sound pressure vs. pulse repetition frequency (parameter: duration of aftereffect).

Only a narrow range of pulse repetition frequencies elicits the aftereffect. Frequencies between 30 and 200 pulses per second seem most effective. This is illustrated in Fig. 2A, where the duration of the aftereffect is plotted as a smoothed function of the pulse repetition frequency, with the peak pressure of the pulses as the parameter. These curves were obtained with three listeners and a constant exposure time of 20 seconds. In Fig. 2B the curves are replotted to show the intensity required to produce a given duration of the aftereffect.

A variety of test stimuli was tried, and the necessary attributes of a good stimulus seem to include familiarity to the listener, complexity in harmonic composition, and temporal discontinuity. Unfamiliar stimuli leave the listener wondering whether or not the test stimulus sounds as it should sound. Pure tones were poor so long as they were continuous; when they were interrupted, the effect was heard *following* the "click" of the interruption. Silence is silent: without a test stimulus our listeners report only a transient, impalpable, nonauditory awareness that an aftereffect persists. The dissipation of the aftereffect seems to be a function of time only and is independent of stimulation. For example, if an exposure normally produces an aftereffect lasting about 3 seconds, a 2-second silence before the presentation of the test stimulus is followed by about 1 second of the aftereffect, and after a silent delay of 4 seconds no qualitative changes are observed.

The quality of the aftereffect does not seem to change as a function of the nature of the stimulations which produce it. It is always the same—a metallic, ringing obligato to the test stimulus.

What possible mechanism could account for this phenomenon? It seems to be peripheral, for if the left ear is exposed to pulses and the right ear is tested with the scraping of sandpaper, no aftereffect is experienced. It is probably related to stimulation deafness, but in no simple manner, since exposures only to certain kinds of sounds are followed by the aftereffect. Furthermore when, a temporary hearing loss produces a qualitative change in a test stimulus, we expect the change to be less pronounced for loud test stimuli, since the temporarily deafened ear is more nearly normal in response to loud than faint sounds. The ringing auditory quality of the aftereffect is, however, most striking and persistent when the test stimulus is made more intense. The mechanism is more complex than a simple subtraction—due to hearing loss—of certain components of the test sound. Either a sharp wave-front or the presence of harmonics properly spaced along the basilar membrane is the necessary condition for producing it. In a highly mechanical system like the ear the possible mechanisms for an afterimage are somewhat limited.

Such, then, is the phenomenon observed. It is not a tinnitus, a simple hearing loss, or a pathological condition. It is a positive aftereffect of the stimulation of normal listeners. Is this not an auditory afterimage?

Reference

1. Bishop, H. G. *Amer. J. Psychol.*, 1921, 32, 305–325.

NEWS *and Notes*

K. A. Gunnar Strand, formerly associate professor of astronomy, University of Chicago, is the new director of the Dearborn Observatory and professor of astronomy, Northwestern University. Dr. Strand, a positional astronomer who did research in navigation for the Army Air Forces during the war, succeeds **Oliver J. Lee,** who had been on the Northwestern faculty since 1928 and who retired August 31. Dr. Strand received his Ph.D. degree from the University of Copenhagen, and came to the United States as a fellow of the American Scandinavian Foundation. His first assignment here was at Sproul Observatory, Swarthmore College. His studies have included the motion of asteroids, determination of position, photographic and visual observations of double stars, and orbital motion in multiple systems. He has been retained as a special research associate at Yerkes Observatory.

Abraham White, associate professor of physiological chemistry, Yale University School of Medicine, will deliver the first Harvey Lecture of the current series at the New York Academy of Medicine, October 23. Dr. White will speak on "Influence of Endocrine Secretions on the Structure and Function of Lymphoid Tissue."

Nathan Birnbaum, Department of Chemistry, City College of New York, has returned to the Department after 5 years of military service with the Chemical Corps, U. S. Army. In addition to overseas duty in New Guinea and the Philippines, Prof. Birnbaum participated in the atomic bomb tests at Bikini as a member of the Radiological Safety Section. He is being retained by the Chemical Corps as consultant to the Research and Engineering Division.

James G. Miller, chief, Clinical Psychology Section, Neuropsychiatric Division, Veterans Administration, Washington, D. C., has been appointed chairman, Department of Psychology, University of Chicago. The appointment, which is effective January 1, 1948, carries the rank of professor of psychiatry and psychology. As a captain in the Army Medical Corps during the war, Dr. Miller served as a neuropsychiatrist, assessing personalities of OSS personnel both in this country and in the European Theater.

Charles C. Price, head, Department of Chemistry, University of Notre Dame, is now in England, where he will deliver a series of special lectures at Oxford, Cambridge, and other colleges and universities in England and Scotland. Dr. Price will also visit the Imperial Chemicals Industries at Manchester and the British Rubber Producers Association at Welwyn Garden City.

Byron Clark has assumed his duties as professor of pharmacology, Tufts College Medical School. Under his direction the laboratories for instruction and research in this field will be reorganized and enlarged.

John H. Melvin, district geologist, Corps of Engineers, Omaha, Nebraska, has been appointed state geologist of Ohio, succeeding **George W. White,** who has been appointed head, Department of Geology, University of Illinois.

Samuel Cate Prescott, of Cambridge, Massachusetts, former dean, School of Science, Massachusetts Institute of Technology, was awarded the honorary D.Sc. degree by Lehigh University at its 69th Founder's Day exercises, October 1.

A. C. Ivy, vice-president of the University of Illinois for the Chicago Professional Colleges, has been named an honorary member of the American Congress of Physical Medicine in recognition of his "studies of electrical stimulation of paralyzed muscles and resuscitation from carbon monoxide asphyxia, and for assistance to the Council of Physical Medicine of the American Medical Association."

William J. Eney, professor of civil engineering, Lehigh University, has been appointed head, and director of the curriculum, Department of Civil Engineering. He succeeds **Hale Sutherland,** who will continue as professor in the Department and will devote more of his time to professional writing.

D. T. Morgan, Jr., has been appointed assistant professor of botany, University of Maryland.

Carl G. Hartman, professor emeritus of physiology and zoology, University of Illinois, has recently been appointed director of physiology and pharmacology, Ortho Research Foundation, Raritan, New Jersey.

Mark W. Woods, associate professor of plant pathology, University of Maryland, has recently resigned to join the staff of the National Cancer Institute, Bethesda, Maryland.

Morris T. James, formerly assistant professor in entomology, Colorado Agricultural and Mechanical College, Fort Collins, has been appointed assistant professor of entomology, State College of Washington, Pullman.

Jacob Sacks, formerly pharmacologist, Endo Products, Inc., has been appointed to the staff of the Department of Biology, Brookhaven National Laboratory, Upton, New York.

Herman C. Lichstein, formerly National Research fellow, Cornell University, has been appointed associate professor of bacteriology, University of Tennessee, Knoxville.

Emily T. Wolff, formerly research botanist at the laboratories of the American Cyanamid Company, Stamford, Connecticut, has been appointed assistant professor of botany, University of Georgia, Athens.

William M. McGill, assistant state geologist of Virginia since 1929, was appointed state geologist, effective September 1, succeeding **Arthur Bevan**, now with the Illinois Geological Survey.

Myron C. Benford, head, Outpatient Department, University of Illinois Hospitals, has been promoted to assistant medical director to assist **John B. Youmans**, dean, College of Medicine and medical director of the hospitals.

Joseph Modrovsky, design engineer, Wright Aeronautical Corporation, Paterson, New Jersey, has been appointed assistant professor, Department of Mechanical Engineering, Polytechnic Institute of Brooklyn.

Frank M. Semans, consulting biologist, and formerly of Hiram College, has been appointed associate professor in biology, Arizona State College, Tempe.

Charles A. R. Connor, associate physician in cardiovascular disease and assistant chief, Cardiovascular Clinic, Lenox Hill Hospital, cardiologist, New York City Department of Health, and attending consultant, Veterans Administration, New York City, has been appointed medical director, American Heart Association, to succeed **David D. Rutstein**, who recently resigned to become professor of preventive medicine, Harvard Medical School.

William Owens, professor of psychology, Iowa State College, has been appointed head, Department of Psychology. During the war Dr. Owens served with the Standards and Curriculum Division, Bureau of Naval Personnel.

S. Richard Silverman, administrative executive, Central Institute for the Deaf, has been appointed director of the Institute, filling the position left vacant in 1941 by the death of **Max A. Goldstein**, who founded the Institute in 1914.

F. J. Alcock, formerly senior geologist, Geological Survey, Mines and Geology Branch, Department of Mines and Resources, Canada, has been appointed chief curator, National Museum, Ottawa.

Lester W. Sharp, professor of botany, Cornell University, retired from active service in the Department on July 1.

A. W. Swensen, professor of chemistry, and **Elmer W. Hertel**, professor of biology, have been promoted to full professors at Wartburg College, Waverly, Iowa.

Milton Tinsley, instructor in neurological surgery, University of Illinois, has been promoted to assistant professor. Dr. Tinsley joined the Illinois faculty in 1940.

Joseph H. Greenberg and **John M. Roberts** have been appointed assistant professors, Department of Anthropology, University of Minnesota, and **Ralph P. Winchester** has been appointed an instructor in anthropology in the General College of that University.

Matilda Moldenhauer Brooks, research associate, University of California, has returned from a summer's work in Peru, where she conducted experiments in the high Andes on overcoming altitude sickness. This work was carried out with the cooperation of C. Hurtado, minister of public health, Peru, and a group of medical men.

Sunder Lal Hora of India, a leading ichthyologist, has been appointed permanent director of the Zoological Survey of India, Kaiser Castle, Benares Cantt, according to a letter received from him by E. W. Gudger, American Museum of Natural History, New York.

Albert S. Cahn, who served during the war as mathematician and physicist with a unit of the Manhattan Project at the University of Chicago, has been appointed executive officer of the Institute of Numerical Analysis, which is being established by the National Bureau of Standards on the campus of the University of California at Los Angeles.

Cecil J. Watson, professor of medicine, University of Michigan Medical School, will address the Institute of Medicine of Chicago and the Chicago Society of Internal Medicine, October 24, at the Palmer House, Chicago, on the topic, "Some Aspects of the Porphyrin Problem in Relation to Disease."

Visitors to U. S.

L. C. Young, of the mathematics research faculty, University of Capetown, South Africa, is in the United States to direct research seminars in mathematics at Ohio State University during the 1947–48 autumn and winter quarters.

Chentze Hsiang Wu, assistant professor of physiology, National Central University Medical College, Nanking, China, who has been working with Maurice B. Visscher, of the University of Minnesota Medical School, Minneapolis, since September 1946, is returning to Nanking this month. Dr. Wu has also been acting as a representative of the Natural Science Society of China to arrange publication exchanges for the Society.

Grants and Awards

The School of Mathematics of the Institute for Advanced Study will allocate a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and do research work at Princeton during the academic year 1948–49. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Application blanks, which may be obtained from the School of Mathematics, Institute for

Advanced Study, Princeton, New Jersey, are returnable by February 1, 1948.

The New York Zoological Society, as administrator of the New York Aquarium and its laboratories, has received grants from the National Advisory Cancer Council of the National Cancer Institute totaling $15,088 for continuing the Aquarium's studies of melanomas in fishes and amphibians. Research on the genetics and biology of normal and atypical pigment cell growth in fishes, initiated by **Myron Gordon,** geneticist, is now being expanded in cooperation with **Ross F. Nigrelli,** pathologist, New York Aquarium. **V. V. Brunst,** formerly director, Laboratory of Roentgen Biology, Roentgen and Cancer Institute, Kiev, and now senior fellow, National Institute of Health, will work on regeneration and transplantation of melanotic tumors in the Mexican axolotls, a colony of which is being established in the Genetics Laboratory of the Aquarium. **Emil Liebman,** formerly research fellow, Department of Biology, Princeton University, will study the hematological and cytochemical changes in progressive stages of normal, pretumorous, and melanomatous fishes. **William** and **Margaret Cordsen Tavolga,** graduate students, New York University Graduate School of Arts and Sciences, Department of Biology, are working on the embryological and endocrinological aspects of the problem. Dr. Gordon is coordinating the entire project at the Genetic Laboratories, temporarily located in the Whitney Wing, American Museum of Natural History.

George W. Merck, president, Merck & Company, Rahway, New Jersey, who directed the Nation's extensive research on biological warfare during World War II, will be awarded the Chemical Industry Medal for 1947 by the American Section, Society of Chemical Industry, at a dinner November 7, at the Hotel Commodore, New York. Mr. Merck was cited for "outstanding accomplishments" by Merck & Company in the field of pharmaceuticals, under his leadership.

Joseph Aronson, U. S. Bureau of Indian Affairs, received the Alvarenga Prize July 14 from the College of Physicians of Philadelphia in recognition of his studies on the evaluation of BCG vaccine in the control of tuberculosis. This prize was established by the will of Pedro Francisco daCosta Alvarenga, of Lisbon, Portugal, an associate fellow of the College of Physicians, "to be awarded annually by the College of Physicians on each anniversary of the death of the testator, July 14, 1883." The College usually makes this award for outstanding work and invites the recipient to deliver an Alvarenga Lecture before the College.

The Spirit of St. Louis Medal, the highest aviation honor of the American Society of Mechanical Engineers, was awarded on September 3 to John K. Northrop, president of Northrop Aircraft, Inc., Hawthorne, California. The medal, awarded every third year, was presented to Mr. Northrop "for his originality and vision in engineering of military and commercial airplanes, and particularly for his development of a successful flying wing."

General Motors Corporation on September 20 received the first annual Distinguished Service Award to be presented by the Special Devices Association, composed of some 600 Naval Reserve officers and civilians who have served in the Special Devices Center, Office of Naval Research. The 1947 award went to General Motors in recognition of "the outstanding accomplishment in its scientific programs involving rapid learning techniques and mass training." While this first presentation was made for wartime and subsequent peacetime contribution to the development of rapid training techniques, the purpose of the award is to promote peacetime advances in such training methods as a measure of national preparedness. Future recipients will be selected solely for current peacetime accomplishments.

Colleges and Universities

A national center for medical research in the field of nutrition is being planned in Chicago under an agreement between Northwestern University and the Spies Committee for Clinical Research. As a first step toward implementing the plans, **Tom D. Spies,** associate professor of medicine, University of Cincinnati, has been named professor of nutrition and metabolism and chairman of a new department in this field at the Medical School of Northwestern. To maintain the department and to support research to be carried out under Dr. Spies the Spies Committee will grant to the University at least $150,000 annually for 5 years. Dr. Spies, who is known for his work with synthetic folic acid, will continue to direct the University of Cincinnati studies in nutrition at Hillman Hospital, Birmingham, Alabama, organized by him in 1937.

Western College for Women, Oxford, Ohio, will dedicate its new $400,000 science building October 11. The new building, completed late in the spring, is now housing the Departments of Biology, Chemistry, Mathematics, Physics, and Psychology. The basement is devoted to a psychology lecture room and laboratory, animal and storage rooms, and physics laboratories for work in X-ray, radiation, glass-blowing, electronics, mechanics, and photography. Offices, classrooms, biology and botany laboratories, additional physics rooms, a greenhouse with a sunken aquarium, and the science library of 26,000 volumes occupy the first floor, while on the second floor are chemistry and biology laboratories, balance room, bacteriology laboratory, preparation room, and a physiology, histology, and embryology laboratory. Two motor control boards provide the necessary electricity for the equipment used. A special deck on the roof of the building serves as an observation platform for classes in meteorology and astronomy.

The University of Rochester has received from Mr. and Mrs. Ernest L. Woodward, of LeRoy, New York, a large residence and 64 acres of land together with funds for remodeling the estate into a rehabilitation hospital for children suffering from cerebral palsy. New York State has appropriated $150,000 toward the hospital, which will be operated by the University with the cooperation of the National Foundation for Infantile Paralysis, the day clinic of the Rochester Cerebral Palsy Association, and the State Health Department. Part of the cost of technical personnel is being borne by the National Foundation under a $292,000 grant to the School of Medicine, made last year for a 5-year program of basic research leading to improvement in the methods of treatment of children disabled by infantile paralysis and cerebral palsy. The Foundation-sponsored program is under the direction of **R. Plato Schwartz,** associate professor of orthopedic surgery at the Medical School, whose work had indicated the similarity of spasticity of muscles in infantile paralysis to that in cerebral palsy. The costs of operation and patient care will be borne by the State. In addition to research and treatment of spastic paralysis, a major aspect of the program will be the training of personnel in any or all of the chief divisions of the plan: research at the School of Medicine, hospital care at the LeRoy unit, and work at the day clinic of the Rochester Cerebral Palsy Association.

Case Institute of Technology has appointed the following to its faculty: **Charles S. Bacon,** associate professor of geology and mineralogy; **Sydney D. Black,** associate professor of aeronautical engineering; **Marvin L. Granstrom,** instructor in civil and sanitary engineering; **Salvatore Cicirello,** instructor in engineering mechanics; **John E. Gilkey,** instructor in machine design; **George H. Wagner,** instructor in metallurgical engineering; **Richard G. Bauman,** instructor in physical chemistry; **Carl F. Schunemann,** instructor in electrical engineering; and **Robert P. Knupke,** instructor in mathematics.

Rensselaer Polytechnic Institute now offers the degrees of B.S. in vocational education and M.S. in education in order to prepare "more and better high school teachers in science, technology, mathematics, and vocational education." The New York State Department of Education and the State College for Teachers at Albany are cooperating in the program, which is under the direction of **Stanley B. Wiltse,** Department of Electrical Engineering.

Southern Illinois University, Carbondale, has added five new faculty members to its science departments, effective this fall. **Joseph Rafalko,** Syracuse University, and **Charles L. Foote,** Wagner College, have been named associate professors of zoology; **Arthur E. Hunter,** a recent graduate of Southern, faculty assistant in zoology; **Wilkison W. Meeks,** Western Maryland College, associate professor of physics; and **Floyd F. Cunningham,** for 17 years head of the Geography Department, State Teachers College, Florence, Alabama, associate professor and acting chairman, Geography-Geology Department.

The measuring engine of the Yale University Observatory, which is used to study large astronomical photographic plates, is now being utilized to check the observations made on the Einstein shift by **George Van Biesbroeck,** professor emeritus of astronomy, University of Chicago, during the solar eclipse of May 20, at Bocajuva, Brazil (*Science*, May 16). While in New Haven, Prof. Van Biesbroeck is the guest of Dirk Brouwer, director, Yale Observatory.

The Einstein shift may be detected during a solar eclipse when the effect of the sun's mass causes a curvature in the path of light coming from the stars by which a star's image is displaced away from the center of the sun by a slight amount. The phenomenon was first tested by Eddington in 1919 and has since been tested by many astronomers. Most of the results have confirmed the Einstein theory, but the amount of the shift has differed appreciably in various expeditions. Prof. Van Biesbroeck improved over previous methods by photographing two points in the sky simultaneously, the star field surrounding the sun and a distant star field brought into the camera by a reflection device. In August he made a second trip to Brazil to photograph the same star field during the night.

The Long Island College of Medicine is now authorized to confer the degree of Doctor of Medical Science, following the Board of Trustees' approval of the expansion of teaching activities to include graduate training in psychiatry, which is the first full-time, long-term graduate course to be offered by the College. The new program in psychiatry is already in progress under the direction of **Howard W. Potter,** *professor of psychiatry.* The training is being given in cooperation with the Veterans Administration Program for training doctors who served in Veterans Administration hospitals and clinics.

Industrial Laboratories

The new contact sulfuric acid works of the E. I. du Pont de Nemours and Company, Inc., located 14 miles from Richmond at James River, Virginia, has begun operations. Du Pont's newest manufacturing unit, which is operated by the Grasselli Chemicals Department, makes sulfuric acid for use by industries in the Richmond area.

M. Vincent O'Shea, Jr., formerly executive vice-president, O'Sullivan Rubber Company, president, Robert Teller Sons & Dorner Company, and president, Rosemarie de Paris, Inc., has been appointed administrative vice-president of Merck & Company, Rahway, New Jersey.

R. C. Mason, on leave of absence for the past year from the atomic energy project, Oak Ridge, Tennessee, has been named manager, Electro-Physics Department, Westinghouse Research Laboratories. Dr. Mason succeeds **Gaylord W. Penney,** who has been appointed Westinghouse professor of electrical engineering at Carnegie Institute of Technology.

William H. Doherty, radio development engineer, Bell Telephone Laboratories, New York City, has recently left for Rome, Italy, to participate in the Rome Radio Congress commemorating the 50th anniversary of Marconi's pioneer radio experiments. Mr. Doherty will present a technical paper on radio broadcast transmitters at the Congress, which is sponsored by the Italian National Council of Research. He will also visit a number of radio stations and scientific laboratories in other parts of Europe to discuss recent advances in radio communication.

Sterling Drug, Inc., has announced the formation of Winthrop-Stearns, Inc., as a new subsidiary to integrate its major pharmaceutical interests in this country. The new company will conduct the business hitherto carried on by Winthrop Chemical Company, Inc., organized by Sterling in 1919 and now being liquidated, as well as the pharmaceutical operations of the Frederick Stearns & Company Division, Detroit, organized in 1855. A similar subsidiary to take over Winthrop and Stearns' Canadian business will be formed in the Dominion as soon as legal requirements are completed. **Theodore G. Klumpp,** formerly president, Winthrop Chemical Company, has been elected president of the new Winthrop-Stearns, Inc.

The Electronic Control Company, Philadelphia, which is engaged in the design of electronic digital computing equipment, has appointed the following to its staff: **Isaac L. Auerbach,** formerly development engineer, Naval Research Laboratory; **Albert Auerbach,** Radio Corporation of America; **Gerald Smollar,** signal engineer, Army Signal Corps; and **Joseph D. Chapline, Jr.,** formerly research associate, University of Pennsylvania, and closely associated with the application of the Differential Analyzer during the war.

Eastman Kodak Research Laboratories have announced the following staff additions: Robert H. Dows, formerly meteorologist, Army Air Forces, will do experimental work on new photographic processes; **Walter R. J. Brown**, who was recently graduated from the University of Toronto, will assist in colorimetry research; and **Elwood J. Hunemorder**, a University of Michigan graduate, will do research in X-ray photography.

Meetings

The National Joint Committee on Fertilizer Application will hold its annual meeting in the Hotel Stevens, Chicago, December 15, in connection with the meeting of the American Society of Agricultural Engineers. The morning program will be devoted to discussion of soil fertility and plant breeding in relation to fertilizer application and radioactive applications to agriculture, while the afternoon program will be concerned with special fertilizer placement studies. Jackson B. Hester, Department of Agricultural Research, Campbell Soup Company, Riverton, New Jersey, is chairman of the Committee.

The Fourth International Congress for Microbiology, held July 20–26 in Copenhagen under the presidency of Thorvald Madsen and with Prof. Orla-Jensen as vice-president, was attended by over 1,100 persons, 87 of whom were Americans representing various branches of microbiology. The Congress was divided into 9 sections including General Microbiology, Medical and Veterinary Bacteriology, Viruses and Viral Diseases, Serology and Immunology, Soil and Water Microbiology, Dairy and Food Microbiology, Industrial Microbiology, Variation and Mutation in Microorganisms, and Plant Pathology and Mycology. General addresses were given by C. H. Werkman (U. S.) on "Assimilation of Carbon Dioxide," F. C. Bawden (England) on "Viruses in General," Ø. Winge (Denmark) on "Yeast in Modern Genetics," and S. A. Waksman (U. S.) on "Antibiotics and Life."

At the conclusion of the Congress the Emil Christian Hansen Prize for Microbiology, consisting of a gold medal and 5,000 Danish crowns and given every three years by the Karlsberg Laboratory, Copenhagen, was presented to Dr. Waksman, the first American microbiologist to receive this award. Dr. Waksman announced that the fund attached to the award will be used to help a young Danish microbiologist come to the United States and spend a year in the Department of Microbiology, New Jersey Agricultural Experiment Station.

The Poultry Science Association held its 36th annual meeting at Clemson College, Clemson, South Carolina, August 25–28, with 351 in attendance at the general sessions and sectional programs on Nutrition, Genetics and Physiology, Extension, Pathology, and Marketing. Awards presented at the banquet meeting, August 27, included the Borden Award of $1,000 for outstanding research work in poultry husbandry over a period of years, to J. H. Jukes, Lederle Laboratories; the National Turkey Federation Award to V. S. Asmundson, University of California; the Poultry Science Research Prize to Paul D. Sturkie, University of New Jersey; the Association's award for outstanding poultry extension work to Fred W. Frasier, Washington State College; and the Association's Teaching Award to E. M. Funk, University of Missouri.

The Association voted to join the Institute of American Biological Societies and to hold its 1948 meeting at the Colorado State Agricultural College, Fort Collins, Colorado.

Officers elected for the coming year were: W. A. Maw, MacDonald College, Quebec, president; H. M. Scott, University of Connecticut, 1st vice-president; W. M. Insko, University of Kentucky, 2nd vice-president; and E. M. Funk, University of Missouri, secretary-treasurer. Directors elected were: R. M. Bethke, Ohio Agricultural Experiment Station; T. C. Byerly, U. S. Department of Agriculture, Beltsville, Maryland; E. W. Callenbach, Pennsylvania State College; and H. S. Wilgus, Colorado Agricultural and Mechanical College. T. C. Byerly, U. S. Department of Agriculture, Beltsville, Maryland, F. B. Hutt, Cornell University, and F. A. Hays, University of Massachusetts, were elected Fellows of the Association.

Recent Deaths

Theodore J. Becker, pharmacologist, Sterling-Winthrop Research Institute, Rensselaer, New York, died August 29.

Tine Tammes, 76, emeritus professor of genetics, University of Groningen, Netherlands, died September 20.

Elmer H. Wirth, 52, head, Department of Pharmacognosy, University of Illinois Professional Schools, Chicago, died September 26 in Chicago.

John Robert Cochran, Jr., 73, Department of Surgery, Northwestern University Medical School, and an attending surgeon, St. Luke's Hospital, Chicago, died September 27.

Clarence Gaines Toland, 72, formerly professor of clinical surgery, University of Southern California, died October 2 of a heart ailment at his Los Angeles home.

Max Planck, 89, German physicist and Nobel Prize winner, and originator of the quantum theory, died on October 3.

Administration for Research, Volume 3 of *Science and public policy*, a series of reports by John R. Steelman, chairman of the President's Scientific Research Board, was released on October 4. In releasing the report, which analyzes a multitude of problems encountered in administering the vast scientific research and development program of the Government and offers recommendations for improvement in administration, the President stated that he is directing Federal departments and agencies engaged in important research and development activities to consider carefully the content of the report and suggested that scientists outside the Government also study the analysis and recommendations which it contains.

The report reveals the urgency of strengthening the Federal machinery in order to (1) determine broad policies, (2) allocate functions, and (3) establish liaison for purposes of closer collaboration not only within the Federal establishment but also with scientific agencies outside the Government. The specific steps proposed include: *appointment by the President of an advisory Interdepartmental Committee on Scientific Research and Development* which would consist of key government officials in charge of various aspects of the Federal research program; *creation in the Bureau of the Budget of a unit to review Federal scientific research and development programs* and thus permit the Bureau to take effective initiative in allocating functions in the field of scientific research; *designation by the President of a White House staff member who would be primarily responsible for liaison* with outside scientists, learned societies, Congressional committees, and Federal scientific agencies; and *establishment of a National Science Foundation*. With respect to the latter recommendation the report had this to say: "It is urged that the Congress establish a National Science Foundation within the administrative framework of the Federal Government. It should be located within the Executive Office of the President until such time as other Federal programs in support of higher education are established [when] consideration should be given to grouping all such activities [including the Foundation] in a single agency. The Board of the Foundation might well consist of part-time members appointed by the President, and the Director of the Foundation should be similarly chosen. Half the membership should be drawn from the personnel of Government agencies with a major role in scientific research and development, and half from among the most eminent scientists and educators outside of the Government."

Other aspects of a sound administration are discussed in subsequent pages of the 324-page report. Among them may be mentioned a lengthy chapter on scientific personnel and discussions of such matters as national security and scientific freedom, the loyalty check, and a more elastic salary system.

The Academy of Time, sponsored by the Benrus Watch Company and located at 200 Hudson Street, New York City, has recently released its first annual report, which was prepared by Julian Lazrus, secretary of the Academy. Since its creation in 1946 as a nonprofit organization, the Academy has provided funds to 9 universities for the scientific study of time. At American University, Ben L. Summerford, Jr., has been working on a project concerned with the relation of time to painting; the funds at Bradley University provided an undergraduate scholarship to William V. Hale, who combined watchmaking with general work leading to a B. S. degree; the recipient at Fordham University was Ruth King, whose project involved the measurement of travel time of elastic waves in the New York Area; at the University of Chicago, Leonard J. Tolmach has been investigating the isotopic ratios of lead in meteorites; at Harvard University, Carl A. Bauer's project is also related to the study of meteors; at Oklahoma A & M, H. G. Thuesen, a professor at the College, has designed and constructed a time recorder of great accuracy; Kees Bol, at Stanford University, is working on the determination of the speed of light in empty space; and at the University of Vermont, Konrad H. Stokes is studying springs in timepieces. The recipient of funds allocated to the University of Minnesota had not been selected at the time the report was prepared. The Academy aims eventually to become a clearing house for all kinds of information on time and time keeping.

Foster D. Snell, Inc., consulting chemists and engineers, are now settled in their new quarters, a 10-story building located at 29 West 15th Street, New York 11, New York.

The program at the Hayden Planetarium, New York, this month, entitled "Autumn Skies," will feature a realistic preview of the Orionid meteor shower, which is scheduled to occur October 22. The shower will occur when the earth passes near the orbit of the famous Halley's Comet, its gravitational pull attracting some of the debris left by the Comet and thus creating meteors. If good "seeing" prevails on October 22, observers will witness a spectacular display. Those unable to watch the real shower may witness it at the Hayden Planetarium, along with many other attractions, each weekday at 2:10, 3:40, and 8:30 P.M., and on Saturdays, Sundays, and Holidays at 10:40 A.M. (Saturdays only), 1:40, 2:40, 3:40, and 8:30 P.M.

A series of 6 lectures on "Modern Psychiatry" will be given in the Town Hall auditorium, 123 West 43rd Street, New York City, beginning Monday, October 20, at 5:30 P.M. The lectures, given under the auspices of the Town Hall Short Course Division, are as follows: October 20, "What Is Mental Health?," Carl Binger, associate professor of clinical psychiatry, Cornell Medical College, and editor, *Psychoanalytical Quarterly*; October 27, "The Psychiatric Implications of Immaturity," Edward A. Strecker, head, Department of Psychiatry, University of Pennsylvania, and staff neurologist, Pennsylvania, Philadelphia, and Germantown Hospitals; November 3, "What Is a Neurosis?," Franz Alexander, director, Chicago Institute of Psychoanalysis, and associate professor of psychiatry, University of Illinois; November 10, "The Psychology of Middle-Aging," Roy R. Grinker, chairman, Department of Neuro-Psychiatry, Michael Reese Hospital, Chicago; November 17, "What Psychotherapy?," Thomas A. C. Rennie, attending psychiatrist, New York Hospital, and associate professor of psychiatry, Cornell University Medical College; and November 24, "Mental Health and World Citizenship," Frank Fremont-Smith, The World Federation for Mental Health, vice-president for the United States.

The Sugar Research Foundation, New York City, has recently acquired from the estate of Charles A. Browne, former staff member, Bureau of Agriculture and Industrial Chemistry, U. S. Department of Agriculture, and historian, American Chemical Society, one of the most comprehensive specialized libraries in existence on the subject of sugar. The collection, which includes more than 200 volumes and 750 bulletins and reprints with many rare and out-of-print works in several foreign languages, will be maintained as the Charles A. Browne Memorial Library at the Foundation's office, 52 Wall Street, and may be consulted for reference or research by students and those having an interest in the subject.

Make Plans for—

Electrochemical Society, Fall Convention, October 15–18, Boston.

Society of Rheology, October 30–31, New York City.

American Institute of Electrical Engineers, Midwest General Meeting, November 3–7, Chicago, Illinois.

American Institute of Chemical Engineers, November 9–11, Detroit, Michigan.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS *by Readers*

In a recent communication to this column (*Science*, August 5, p. 127) Drs. Dicker and Heller critically reviewed a recent paper of the writer dealing with the creatinine, inulin, and hippurate clearance of the rat (*Amer. J. Physiol.*, 1947, **148**, 387). It was their belief that (1) the preliminary and very brief (less than 5 minutes) ether anesthesia given to the rats preceding our clearance studies, (2) handling of rats during the clearance, (3) withdrawal of 1.0–1.75 cc. of blood from the rats before the clearance, and (4) the possible variation of the blood creatinine during a possible two-hour collection period, all tended to give us results which might not be comparable to those obtained by Drs. Dicker and Heller, who employed collection methods which they believed to be more physiological.

If factors (1), (2), and (3) above were operating in our clearance studies, they acted as the authors themselves have stated (*J. Physiol.*, 1945, **103**, 449), namely, to depress renal clearances. This, then, makes it difficult to understand why our average inulin clearance (19.1 cc.) at our lowest rate of urine flow was approximately the same as the average inulin clearance (21.06 cc.) of all of their clearances and why our average inulin clearance (41.1 cc.) at a high rate of urine flow was 90 per cent higher than theirs. The same discrepancy holds for their and our rates of renal plasma flow. In other words, if our technique supposedly depressed clearances, thus making them different than theirs, why are our clearances so much higher?

Concerning the fourth factor (the creatinine variation), we found, in preliminary determinations taken every 15 minutes during the collection period, that the blood creatinine remained relatively unchanged. Drs. Dicker and Heller assume that we conducted a two-hour collection because of small urine collections. We stated in our paper that the two-hour collection was designed to avoid the necessity of making clearance calculations on total collection volumes which might not exceed 0.07 cc. of urine, as occurred in some of Dicker and Heller's experiments. We further stated, and still believe, that their clearances were erroneously low because of possible urine losses attending such small collections.

Drs. Dicker and Heller are referred to the clearance results of the rat as given by Drs. Braun-Menendez and Chiodi (*Rev. Soc. Arg. Biol.*, 1946, **23**, 314). In this independent study of inulin and diodrast clearances of the rat, clearances were obtained by a technique differing from ours. Nevertheless, Dr. Braun-Menendez has informed me (as a review of his article will also demonstrate) that his clearances were almost identical with ours. Furthermore, both he and Dr. Chiodi were convinced that their clearance values varied with the urine flow. (MEYER FRIEDMAN, *Mount Zion Hospital, San Francisco, California.*)

* * *

In the years to come American scientists will presumably wish to participate actively in international conferences, some of which may be called on fairly short notice. The story that follows may serve to illustrate the kinds of obstacles that one may encounter because of passport difficulties. We must find ways of eliminating obstacles of this sort.

Early in August I received an official confirmation of a provisional invitation for me to attend a three-day conference called for September 11–13 by the Committee on Science and Its Social Relations (CSSR). This confirmation was in the form of a telegram from Dr. F. J. M. Stratton, chairman of the CSSR and also secretary of the International Council of Scientific Unions (of which the CSSR is a committee).

Certain preliminaries had to be taken care of, and, on August 18, I presented in person at the office of the Passport Division of the State Department in Washington, D. C., a fully-documented passport application. A passport that had originally been issued to me in 1938, and which was recalled as a matter of routine in 1941, was on file in Washington. The clerk who received my application assured me that my passport would be issued within a week. I informed him that I was making air reservations to leave September 6 or 7.

Accompanying the passport application was an official personal letter of endorsement from Dr. Detlev W. Bronk, chairman of the National Research Council, in which he requested the issuance of a special passport. In this letter Dr. Bronk pointed out that as a part of this trip to Europe I would also stop in Paris at UNESCO Headquarters, a visit that was highly desirable for me as chairman of the NRC Committee on UNESCO.

I was preparing to leave on September 7, but when, after two weeks, no passport came, I went (again in person) to the Passport Division and inquired about the reasons for the delay. The reception given to me was kind and courteous, but I was informed by the assistant chief of the Passport Division that he could not issue a passport as long as "official clearance" had not been obtained. He promised to send me the passport himself, the moment the needed clearance would come through.

The NRC then renewed its efforts to obtain a passport in time for me to proceed to the London meeting. I informed Dr. Harlow Shapley of the unexpected delays, and he sent a telegram to the Secretary of State, urging that a passport be issued to me right away. Dr. Shapley sent this telegram in his capacity of president of the AAAS.

A personal inquiry by me to the head of the Federal Bureau of Investigation revealed that the issuing of the required clearance was wholly in the hands of the State Department.

On September 9 I talked by telephone with the assistant chief of the Passport Division, who held out hopes that a passport might come through later that day or early the next day. He offered to do everything possible to speed me on my way if the needed clearance were to come through on September 9 or 10. The "security investigation" was, however, not completed in time, and no passport was issued. On September 10 I had to telegraph to London that I would be unable to attend the London meeting.

I understand that another scientist

who was invited to attend the London meeting of the CSSR was also prevented by passport difficulties from going. The readers can judge for themselves what sort of impression our European colleagues must have formed of the importance which our State Department attaches to international scientific conferences. (BART J. BOK, *associate director, Harvard Observatory.*)

* * *

Current interest in the therapeutic use of cytochrome C is widespread as a result of a series of papers by S. Proger and associates (*Science*, October 25, 1946, pp. 389–390; *J. clin. Invest.*, 1945, **24**, 864). In an attempt to provide a rational basis for their therapeutic studies, these workers drew certain conclusions which we feel are unjustified. It is understandable that such erroneous conclusions could be drawn, but it is undesirable to have them go unchallenged. The points at issue are as follows:

(1) Proger, *et al.* stated (*Science*, October 25) that "the organs normally contain considerably more cytochrome oxidase than can be activated by the cytochrome C present," based upon our data for cytochrome C content of organs (V. R. Potter and K. P. DuBois. *J. biol. Chem.*, 1943, **142**, 416) and cytochrome C requirement for *in vitro* assay of cytochrome oxidase (W. C. Schneider and V. R. Potter. *J. biol. Chem.*, 1943, **149**, 217). This conclusion is not permissible because the amount of cytochrome required in the assay system is not an indication of how much is needed in the cell and was not intended to be. Proger, *et al.* apparently overlooked the fact that the substrate for cytochrome oxidase is *reduced* cytochrome C, and that the amount of *reduced* cytochrome available to cytochrome oxidase is a function not only of the total cytochrome C present but of the *rate of reduction.* In the assay system this reduction is nonenzymatic and slow; hence, large amounts of cytochrome are used. In the cell the reduction is enzymatic. *Thus, there is no evidence to indicate that cytochrome oxidase needs more cytochrome C than it has available in the cell.*

(2) Proger, *et al.* stated in both articles cited that the cytochrome content of blood and organs was increased following cytochrome C injection. The method used was that of Potter and DuBois. This method does not permit one to decide whether the cytochrome C has penetrated to the inside of the cells or whether it is in the blood and tissue spaces, and was not claimed to do so. In uninjected animals the blood does not contain cytochrome in significant amounts, but this is obviously not the case in the injected animals. *Thus, there is no evidence that injected cytochrome C reaches the interior of the cells.*

(3) Proger, *et al.* also stated that the addition of cytochrome C to homogenized tissue caused increases in oxygen uptake, and concluded that similar amounts of cytochrome C would produce comparable increases *in vivo*. But we have repeatedly emphasized the fact that when a tissue is homogenized, the cytochrome is "diluted" to an extent that depends upon a variety of factors; the extent of the dilution determines the extent of the "stimulation" when cytochrome C is added back. In the intact cells, the cytochrome C is apparently localized in the particles that contain cytochrome oxidase (W. C. Schneider, A. Claude, and G. H. Hogeboom, to be published). There has been no demonstration that the stimulation of oxygen uptake by cytochrome additions observed in homogenates can be duplicated *in vivo*, although the possibility remains that the factors which are concerned in the dilution of cytochrome in homogenates may occasionally operate *in vivo*.

(4) Proger, *et al.* (*J. biol. Chem.*, 1945, **160**, 233) reported that cytochrome C administration prevented the anoxic depletion of the high-energy phosphate reservoirs of the tissues. To me, this experiment would be decisive if it could be confirmed. Unfortunately, the original experiment was done without the precautions that are necessary to preserve the phosphate compounds (G. A. LePage. *Amer. J. Physiol.*, 1946, **146**, 267), and Scheinberg and Michel (*Science*, April 4, pp. 365–366) have failed to confirm the observation.

(5) There remains the final test, clinical benefit, which we are in no position to judge. We have been advised of two unpublished studies with experimental animals that gave negative results. It is desirable that the findings of Proger, *et al.* be tested by some disinterested group as soon as possible in order to prevent a great deal of unnecessary duplication of effort. At present nearly every major pharmaceutical house is undertaking to prepare cytochrome C. It is not the function of these companies to referee conflicting reports, and if the demand for cytochrome C continues, it will be met. But the demand is not a proof of efficacy.

(6) Finally, it must be noted that sound clinical results will stand regardless of their theoretical basis. It may be that cytochrome C will prove beneficial for reasons as yet unknown. (VAN R. POTTER, *University of Wisconsin Medical School.*)

[The above comment was sent by the author to Dr. Proger for criticism before being submitted for publication. Dr. Proger's reply will appear in next week's issue.]

* * *

The unfertilized egg of an oyster is pear shaped. In the ripe, unspawned ovary the eggs are tightly packed and compressed. The diameter of the rounded portion of an egg in the oysters kept at Woods Hole is about 40 μ. Assuming that the egg is a sphere, its volume is equal to $\frac{4}{3}\pi R^3$, or 1.33 × 3.1416 × 8,000 μ. The volume of 100,000,000 eggs is therefore only 3.3 cc. A certain correction, probably not exceeding 20 per cent, should be added to this figure to account for the void spaces between the eggs. Since the volume of the body of an adult female oyster (without the shell) varies from 15 to 25 cc., the estimated volume of eggs discharged in one spawning is not unreasonable, for it is known that the oysters lose a considerable portion of their body weight after the discharge of sex products.

In the past, too much significance was given to the number of eggs produced by females. Studies conducted by the U. S. Fish and Wildlife Service show that in Southern waters the spawning season extends from early May to October. It is therefore quite possible that the growth of the ovocytes is a more or less continuous process. This point requires further studies which are being conducted at present by the U. S. Fish and Wildlife Service. Potential fecundity of the oyster has, however, little bearing on the success or failure of reproduction, the latter primarily depending on the survival of the oyster larvae rather than on the initial abundance of spawned eggs.

I believe this brief note answers Mr. Burkenroad's criticism of my paper (*Science*, September 26, p. 290). PAUL S. GALTSOFF, *U. S. Fisheries Station, Woods Hole, Massachusetts.*)

TECHNICAL PAPERS

Citric Acid in Saliva

Isadore Zipkin

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Positive evidence for the occurrence of citric acid in human saliva appears to be limited to a report by Pucher, Sherman, and Vickery (*5*), who found 0.04–1.30 mg. per cent citric acid present in 7 specimens. Previously, Kuyper (*1*) and Leake (*2*) were unable to detect citric acid in saliva. However, they both used methods which at the time were unsuited to detect less than 2.0 mg. per cent. With slight modifications the method proposed by Perlman, Lardy, and Johnson (*4*) has been adapted to saliva analysis using 10-cc. quantities. Some 180 saliva specimens obtained from 15 adult men have been analyzed, and the results (Table 1) afford considerably more evidence of the presence of citric acid in saliva than has been available heretofore. Paraffin-stimulated saliva was collected on three days at four different times, *i.e.* 9 A.M., 11 A.M., 1 P.M., and 3 P.M. The figures in the table are averages for three days according to time of day for each individual.

TABLE 1

CITRIC ACID* IN STIMULATED SALIVA

(Mg./100 cc.)

Case	9 A.M.	11 A.M.	1 P.M.	3 P.M.	Average
1	0.44	1.24	1.21	1.37	1.07
2	0.73	0.55	0.85	0.51	0.66
3	0.60	0.57	0.83	0.66	0.67
4	0.79	0.89	0.87	0.72	0.82
5	0.56	0.60	1.04	0.75	0.74
6	0.56	0.56	0.64	0.68	0.61
7	0.86	0.70	1.37	1.02	0.99
8	1.42	1.94	1.95	1.61	1.73
9	1.74	2.14	2.40	1.86	2.04
10	1.19	1.13	1.81	1.51	1.41
11	0.98	1.00	1.42	1.25	1.16
12	0.88	0.92	1.31	1.11	1.06
13	0.67	0.55	0.81	0.52	0.64
14	1.48	1.49	1.56	1.61	1.54
15	1.00	1.40	1.13	1.31	1.21

* *Expressed as the monohydrate.*

These results support the data of Pucher, *et al.* (*5*) and indicate that the average male adult's saliva may contain 0.50–2.00 mg. per cent citric acid. In nearly every case, results of triplicate analyses were quite consistent. In addition, samples taken every two hours throughout the day were essentially consistent, except perhaps for the slightly higher values for the 1 P.M. specimens.

Further studies are contemplated, particularly on the relation of salivary citric acid to dental erosion and dental caries. Decalcification of dental tissues by citrate ion is suggested by the observation that calcium and citrate form a soluble, slightly ionized complex (*6*). Also, it has been observed in previous studies from this laboratory that citrate in practically neutral drinking fluids has a pronounced destructive action on dental tissues *in vivo* (*3*).

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Wright's Hypothesis: Its Relation to Volume Growth of Tissue Cells and Mitotic Index

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In studying the length of time spent by cells in the different stages of mitosis Wright (*6*) first stated and made use of the following hypothesis: The fraction of the total time of mitosis spent by a cell in a given phase of mitosis is equal to the ratio of the number of cells found in that phase to the number of cells found in all phases of mitosis. According to this hypothesis it is possible to determine the time duration of all phases of the mitotic process if one can observe the duration of a single phase. For example, Wright estimated that telophase required 5 minutes for chicken-heart cells incubated at 37°C. From this time and the percentages of cells found in the various phases he established the time schedule for the mitotic cycle, the total duration of which turned out to be 34 minutes.

On the other hand, the mitotic index has been used as a measure of the rate of growth of cells in tissues (*3*, *4*). This interpretation placed on the mitotic index assumes tacitly that the time required for mitosis, T, is constant. It can be shown that the mitotic index is proportional to the product of the time of mitosis, T, and the rate of cell division. For the important case of exponential growth of tissue volume such as occurs in liver regeneration (*1*, *4*) and in transplantable mouse-tumor growth (*2*, *5*) it can be shown that the mitotic index, m/M, is equal to $(e^{\lambda T} - 1)$ in a first approximation, where λ is the characteristic growth constant in the tissue volume growth law, $v = v_0 e^{\lambda T}$. Values of λ have been measured for regenerating liver: $\lambda = 1.33$ days^{-1} (*1*), and for transplantable tumors: $\lambda = 0.37$ days^{-1} (*5*). Since T is usually of the order of 40 minutes, the product λT is small, and the mitotic index is: $m/N = \lambda T$. This equation indicates the basis for Wright's hypothesis if one considers m as being the number of cells in any one of the stages of mitosis and T is the time spent by the cell in that stage. However, λ is a measure of the growth rate and must be assumed to be constant.

The biologic variation can be taken into account by considering the "partial mitotic index," $m_i/n_i = \lambda_i T_i$. The total mitotic index becomes:

$$\frac{m}{N} = \frac{\Sigma m_i}{\Sigma n_i} = \frac{n_i \lambda_i T_i}{\Sigma n_i}. \tag{1}$$

If T_i is the same for all cells in the tissue mass, the mitotic index becomes:

$$\frac{m}{N} = \frac{T}{N} \{n_1 \lambda_1 + n_2 \lambda_2 + \cdots + m_r \lambda_r\}, \tag{2}$$

indicating again that the index is proportional to the product of T and the volume rate of growth of the tissue. The biological variation, *i.e.* the distribution of cells into the numbers n_1, n_2, n_3 .....can be measured by measuring the volumes of cells in early prophase. This will give a frequency distribution of volumes which, when compared with the frequency distribution of volumes of all cells in the tissue, should give a measure of the fraction of cells in the so-called "resting stage." This fraction is of interest in exponentially growing tissue masses because it indicates the possibility that the growth constant, λ, for the entire tissue mass is less than that for the cells which actually contribute to the growth. Values of $\lambda = 1.33$ days^{-1} lead to a volume-doubling time of 0.3 days. If a fraction of all cells are resting, the growing cells must double their volumes (on the average) in a time less than 0.3 days.

In the case of a transplantable mammary adenocarcinoma (*2, 5*), for small tumor volumes (less than 0.5 cc.), the volume growth of all cells can be considered approximately equal. Here Wright's hypothesis may be generalized and applied to the distribution of cell volumes to measure the rate of growth of the tumor mass. According to the hypothesis, the number of cells, Δn, having volumes in the interval, Δv, for a time, Δt, is given by

$$\frac{\Delta n}{N} = \frac{\Delta t}{L}, \tag{3}$$

where L is the intermitotic time and N is the total number of cells. If the frequency distribution of volumes is $\phi(v)$ then $\Delta n = \phi(v)\, \Delta v$, and the intermitotic time is

$$t = \frac{L}{N} \int_{v_0}^{v} \phi(v)\, dv. \tag{4}$$

Here v_0 is the smallest volume in the distribution, and t is a function of v. Equation 4 is the inverse of the tissue growth function, $v = V(t)$, and permits the determination of volume growth by means of the distribution function, $\phi(v)$. It can be shown that for exponential growth in the ideal case the function $\phi(v)$ is of the form $1/v$. Preliminary integration of the volume distribution of cells published (*2*) shows that Equation 4 leads to a logarithmic relation between t and v with a characteristic constant, $\lambda = 0.44$ days^{-1}, where the measured value was $\lambda = 0.37$ days^{-1}. Improved techniques for measuring the cell volume distribution are being developed. The method must be tested on tumors of various ages to ascertain the possible effect of "resting cells" on the volume distribution. It should be emphasized that this use of Wright's hypothesis applies only to a homogeneous, dedifferentiated group of cells having uniform growth rate.

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Germination and Free Fatty Acid in Individual Cotton Seeds

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Seeds from cotton that has been exposed to wet weather in the field are likely to be lower in viability and to contain higher percentages of free fatty acids than those from seed cotton harvested without unfavorable exposure (*3, 4*). Similar observations have been made of cottonseed stored under conditions of high moisture or temperature (*4*). Conventional methods of approach to the relationship of free fatty acid content to germination would require that a sample of several hundred grams of cottonseed for the free fatty acid determination and another sample of several hundred seed for germination tests be drawn from each lot tested. When sufficient data were obtained, statistical methods could be used to study the relationship between the two variables. A second approach to the problem consists of the application of microchemical methods to the analysis for the free fatty acid content (*2*) of part of the nongerm portion of a single seed and the germination of the remainder of the seed.

In order to establish whether the free fatty acid content of the nongerm end of a hulled cotton seed was correlated with that of the germ end, 50 seeds were carefully peeled and cut approximately in half; each half was weighed and placed in a numbered, small, glass-stoppered Erlenmeyer flask. To each flask 5 ml. of petroleum ether (American Oil Chemists' Society, Specification H 2–41) was added and allowed to stand for about 30 minutes to soften the seeds. The seeds were then ground by means of a glass rod with a flattened end. Any material adhering to the rod was washed into the flask by means of an additional 5 ml. of the petroleum ether. The flasks were then stoppered and allowed to stand for about 16 hours with occasional shaking. After the extraction was completed, 10 ml. of neutralized alcohol containing m-cresol purple indicator was added and the mixture immediately titrated with 0.005 N alcoholic KOH. During the titration the effect of atmospheric carbon dioxide was eliminated by bubbling a stream of carbon dioxide-free air through the titration flask. The free fatty acid content is calculated as per cent oleic acid by multiplying the milliequivalents of alkali used by 28.2 and dividing the product by the weight of the portion of kernel extracted. These values may be put in terms of the free fatty acid in the oil by multiplying by 3, since the kernels contain approximately one-third oil.

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The fatty acid content of the germ ends varied from 0.4 to 23.6 per cent and averaged 6.9 per cent; that of the nongerm ends, from 0.4 to 23.8 per cent with an average of 7.2 per cent. The correlation coefficient was 0.79, indicating a highly significant, though not by any means perfect, correlation between the free fatty acid contents of the two ends of a cotton seed. Analysis of the composited germ ends and composited nongerm ends of several hundred cottonseed showed that the nongerm end contained 39.5 per cent oil, while the germ end contained 38.7 per cent.

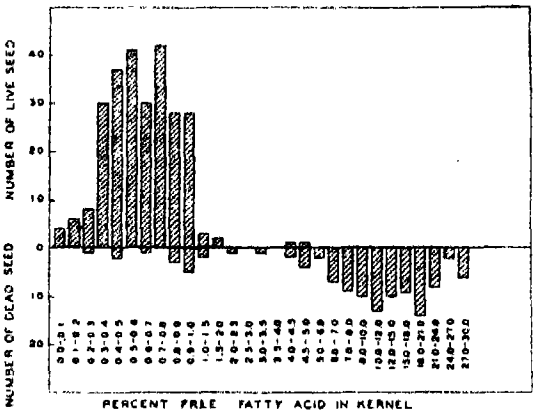

FIG. 1. Distribution of viable cottonseed according to per cent free fatty acid in kernel.

The seeds used to obtain the data plotted in Fig. 1 were selected from 10 sample lots of seed: three lots from the 1941 crop, five from the 1942 crop, and two from the 1943 crop. The seeds used were from experimental plots grown at Tifton, Georgia, Florence, South Carolina, Knoxville, Tennessee, and Baton Rouge, Louisiana, and included the following varieties: Coker's Farm Relief No. 5, Coker's 100 str. No. 3, Acala 1-13-3-1, Rowden 42A, Stoneville 37-10, and Arkansas Green Lint. The seeds were carefully hulled by hand using a razor blade. They were then cut approximately in half perpendicular to the long axis. The germ end was sterilized by dipping in a solution containing 0.25 gram of mercury bichloride dissolved in a liter of 50 per cent ethanol (*1*). After being rinsed in sterile distilled water the germ end was almost completely submerged, pointed end down, in sterile nutrient agar in a numbered test tube, and after being covered with a sterile cap the tube was placed in the dark to germinate. When growth above the agar, accompanied by root formation, was noted, germination was rated positive. If such growth was not observed within two weeks, the seed was rated dead.

The nongerm end was weighed, placed in a numbered flask, extracted and titrated as described above.

In Fig. 1 are shown the results obtained from 369 individual cotton seeds. Several dead seeds were found whose nongerm end contained less than 1 per cent fatty acid. These may have been seeds which were nonviable from some cause which did not produce an increase in acidity or seed in which the acidity development was higher in the germ end than represented by the analysis of the nongerm end. All seeds whose nongerm end contained over 5 per cent of fatty acids were dead. A striking feature of the data is that so few seeds were found whose nongerm end contained from 2.0 to 4.0 per cent fatty acid. Only two seeds were found, probably indicating a rapid rise in fatty acid content in this range. Two seeds having fatty acid content in the nongerm end in excess of 4.0 per cent were found to be viable. Since these showed some discolored spots, the value for fatty acid obtained on the nongerm end is probably considerably higher than that of the germ end. The data indicate that most (over 71 per cent) of the seeds contained less than 1 per cent of free fatty acid, whereas the fatty acid content of the others ranged from 1 to 30 per cent. In the group of seeds containing less than 1 per cent the number of live seeds was about 21 times the number of dead seeds, while in that containing from 1 to 30 per cent there were 14 times as many dead as live seeds.

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Oral Efficacy of BAL in Protecting Rats Against Alloxan Diabetes

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BAL (British anti-lewisite), administered intravenously or subcutaneously as recently reported by us (*2, 3*), gave complete protection against the diabetogenic and lethal effect of alloxan in rats. The effective intravenous antidiabetic-dose-50 of BAL against a dose of alloxan otherwise producing diabetes in 100 per cent of injected animals was approximately 8 mg./kg. BAL was thus effective in appreciably smaller doses than cysteine (*1*). BAL administered intravenously or subcutaneously afforded complete and permanent protection against alloxan diabetes for 85 minutes and reduced the lethal effect of alloxan to approximately half.

Recently we have found that BAL also protects rats from alloxan diabetes by the oral route of administration, as shown in Table 1.

TABLE 1

Dose of BAL per os mg./kg.	No. of rats protected
75	0/7
110	4/7
162	5/9
237	7/7

Thus, not only is BAL effective in reducing the toxicity of alloxan, a nonmetallic compound, but it can exert its effect by the oral as well as the parenteral route.

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[1] With the technical assistance of Mary Ann Griffith.

The Origin of Monocytes in the Spleen

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In recent studies on the reactions of the RES to various antigens and during infectious processes, observations were made by the writer which seem to indicate the site of origin of monocytes in the spleen. These observations were made in guinea pigs which had been inoculated with bacterial toxins or which were carriers of experimental brucellosis.

The histological study of the spleen in these cases showed peculiar reactions which were characterized by regressive or proliferative changes in the lymph follicles and by the presence of numerous mononuclear cells in the sinuses of the pulp. These mononuclears may be regarded as being perfectly identical with monocytes or macrophages. Generally they have a large, rounded or kidney-shaped nucleus with scarce chromatin, and slightly acidophile and well-developed cytoplasm. In the case of *Brucella* infection they appear in great numbers showing marked phagocytic activity, their cytoplasm containing red blood cells as well as cell particles and granules of hemosiderin.

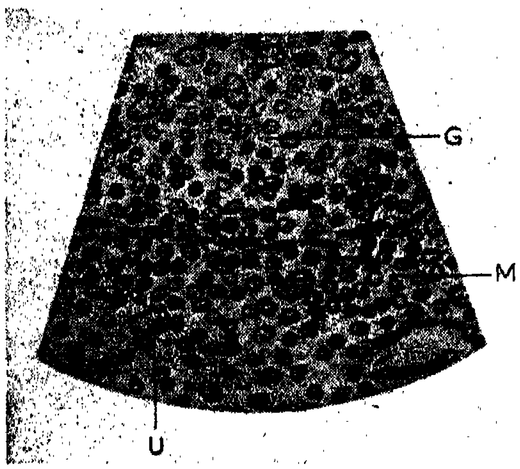

FIG. 1. Sector of a Malpighian corpuscle: G, germinal center; M, marginal zone; U, undifferentiated cell. Hematoxylin-eosin stain. (About 700 X.)

What seemed particularly interesting, however, was the fact that, according to our findings, these elements apparently derive from the marginal zone of the follicles. Here numerous mesenchymal, undifferentiated cells are found proliferating, especially during the infectious process, and apparently producing the monocytes, which emigrate and fall into the lumen of the perifollicular sinuses.

Therefore, a picture similar to that observed in the lymph-nodes is found in the spleen. In fact, at the periphery of the lymph-node follicles, undifferentiated or germinal cells can be seen which are equally considered as a source of monocytes (*1*).

There are, then, evidences that two types of cells, with different morphological characteristics, derive from the lymph follicles or Malpighian corpuscles of the spleen, viz., cells that are typical lymphocytes, which come from the germinal centers, and the elements we have described as monocytes, which apparently originate from the marginal zone of the follicles.

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Ultraspectrophotometric Studies in Extracts of Normal and Tumor Tissue of Human Origin

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Histologic properties frequently have a chemical correlate traceable also after cell destruction. It seems highly probable that the cell characteristics of malignant tumors should become manifest in their extracts as an increase of the nucleic acids or their cleavage products. Claude and Rothen (*1*), Thomas (*3*), and Stowell (*2*) suggest that nucleic acids or their protein compounds may be part of the active principle of tumor formation. Our studies are based on ultraspectrophotometric analysis of tissue extracts.

Tissues were obtained at operation in 26 cases, postmortem in 4. Fourteen specimens were from malignant tumors, one each of Hodgkins' disease and leukemia, and three from benign tumors. Seven were inflammatory lymph-nodes, one an inflammatory tumor. The tissue was finely cut, suspended in saline solution (pH 7.2–7.4), and heated ½ hour at 65°C. to inhibit enzyme action. It was centrifuged for ½ hour at 9,000 r.p.m. in an angle centrifuge. For ultraspectrophotometric studies, a DU Beckman electric quartz spectrophotometer was used. Comparison of the optical density of the solutions was made in the same quartz cell at equal degrees of dilution. Measurements were made in steps of 10 A. between 3,100 and 2,200 A.

Normal leucocytes showed a faint indication of selective absorption at 2,600 A., but the graph looks rather S-shaped within a wave-length range between 2,800 and 2,500 A. Normal liver and endometrium are characterized by selective absorption with a peak at 2,650 A. Seven inflammatory lymph-nodes gave uniformly selective absorption with a peak in 6 cases at 2,500 A. An inflammatory tumor of the breast had an S-shaped absorption graph. Nine carcinomas showed selective absorption at 2,600 A.; a scirrhous tumor had an S-shaped graph. The height of the peak seemed in certain relation to the number of cells in the neoplastic tissues. One case, a medulloblastoma, was distinguished by two peaks at 2,550 and 2,700 A. Three lymphosarcomas and one Hodgkin's case gave similar absorption graphs with peaks at 2,600 A. Of the lymphosarcomas, one was atypical but was so clinically and histologically, diagnosis being based on tissue culture. The absorption peak in a case of lymphatic leukemia (chronic) was 2,500 A. Of the three benign tumors, two showed no selective absorption, one a low peak at 2,550 A.

Tentative suggestions can be offered regarding the selective absorption peak at 2,650 A. in normal liver and endometrium, 2,600 A. in carcinoma, and 2,500 A. in the inflammatory nodes.

From a diagnostic point of view, these differences in various pathological conditions seem of interest. The underlying causes will be the subject of further research.

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Inactivation of Staphylocoagulase by Trypsin and Pepsin[1]

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Staphylocoagulase is a substance, present in filtrates of cultures of pathogenic staphylococci, which has the property of coagulating plasma. Despite its name, which would imply enzymic character, little is known of either its chemical nature or its mode of action. Walston (*2*) found that the active principle was not dialyzable from crude filtrates and was present in the precipitates obtained with alcohol, dilute acetic acid, or half-saturated ammonium sulfate. He also stated that the activity is destroyed by tryptic digestion. The present report is concerned with further study of the effects of trypsin and pepsin on the activity of staphylocoagulase.

Cultures of a coagulase-positive *Staphylococcus aureus* grown for 7 days in tryptic digest medium were used as the source of coagulase. After incubation, 0.5 per cent of phenol was added as a sterilizing agent, the organisms removed by centrifugation, and the clear supernates used. Coagulase activity was titrated by a serial dilution procedure in which 0.5 ml. of each dilution was mixed with an equal amount of fresh, sterile, citrated human plasma. The titer of coagulase was considered to be the highest final dilution yielding a clot filling about half the volume of the mixture at the end of 2 hours.

TABLE 1

Proteolytic Digestion of Staphylocoagulase

Enzyme	pH of digestion	Coagulase titer		Percentage decrease in protein N
		Before digestion	After digestion	
Trypsin	8.7	128	0	77
"	8.7	128	0	74
"	8.7	128	0	81
"	8.7	64	0	80
Inactivated trypsin	8.7	64	64	0
None	8.7	128	64	0
Pepsin	2.0	64	0	70
"	2.0	128	0	64
"	2.0	128	0	72
Inactivated pepsin	2.0	64	64	0
None	2.0	128	128	0

Commercial trypsin (Pfanstiehl) and U. S. P. pepsin (Merck) were used. Five ml. of the supernate plus 20 mg. of the enzyme were incubated at the appropriate pH and 37°C. for a period of 2–2.5 hours, with occasional shaking. Controls were run for each enzyme using heat-inactivated enzyme and also with no enzyme present. Before carrying out the titration of coagulase, tryptic action was checked by heating for 5 minutes at 80°C.; peptic action, by adjusting the reaction to pH 8. The preparations were cleared by centrifugation, and the coagulase titer was then determined. The activity of the enzyme preparations was checked by measuring the protein nitrogen, *i.e.* that precipitated by 5 per cent trichloroacetic acid, before and after the incubation.

The results are shown in Table 1. There was complete destruction of coagulase activity in all experiments with active enzymes. There was a one-dilution decrease in coagulase activity in one of the controls, otherwise no decrease in the controls.

This work bears upon the question of the enzymic or nonenzymic nature of staphylocoagulase. Its extreme resistance to thermal inactivation (*1*) raises some doubt as to its being a typical enzyme. The complete destruction of coagulase activity by trypsin or pepsin indicates that it contains peptide linkages hydrolyzable by these enzymes. If coagulase activity depends upon intact protein structure, it is remarkably stable when heated, since we have been able to confirm Gengou's observations and extend them by the observation that 20 minutes at autoclave temperature (120°C.) does not abolish the coagulase activity of staphylococcal culture-supernates.

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Linkage Between the Genes for Sickle Cells and the M-N Blood Types[1]

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It has often been pointed out that the detection of instances of linkage in man is of importance not only in an academic sense but also in order to make more precise genetic prognoses for the occurrence of anomalies and diseases (*3, 4*) and to institute preventive measures on the basis of early recognition of preclinical signs (*2*). Various methods of analyzing family data for linkage have been formulated (*1, 3*).

We have recently been investigating the linkage relationships of the genes for sickle cells and for the various blood groups and types. To date, 33 families have been tested. Although we found no evidence against random assortment between the gene for sickle cells and the genes for the A-B blood groups and the Rh types, we did find evidence that the gene for sickle cells is linked with those for the M-N blood types.

In order that any family may furnish information on the linkage between two genes, it is necessary that at least one parent be heterozygous for both pairs of genes. The gene for sickle cells is rare enough that any sickle cell parent is almost certain to be heterozygous. Out of our 33 families there were 5 in which one parent had sickle cells and was type MN. Following the procedure of Finney (*4*), these may be arranged as follows:

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[1] Studies in Human Inheritance XXXIII.

Family	Finney Type	a	b	c	d	λ	K
7	4	3	0	0	1	6	6
8	4	1	0	0	2	3	3
11	4	1	2	1	0	0	6
17	4	0	1	0	1	−1	1
30	3	2	0	0	0	1	1
Totals................................						9	17

The total score (summation of λ) is seen to be 9, with a variance (summation of K) of 17. Since the total score exceeds $1.64 \sqrt{\text{summation of K}}$, there is significant evidence against the hypothesis of random assortment, and we may consider that the existence of a linkage between the genes for sickle cells and for the M-N blood types has been demonstrated. As rapidly as possible we are adding to the collection of families.

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Spleen Extract and Tumor Growth

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The relationship between the spleen and neoplastic growth has been the subject of numerous papers, only a few of which can be mentioned here (e.g. *4*). Interest in the subject has been stimulated by the fact that primary carcinoma of the spleen has almost never been found and cannot be experimentally induced; nor is there growth of tumor tissue even when fragments are implanted directly into the organ (*1*). Metastases to the spleen from primary growths at other loci are also infrequent, and diffuse neoplastic infiltration of the spleen does not occur. The use of spleen extracts in tumor therapy has also been the subject of much controversial discussion, but that there is some definite inhibitory effect of spleen extract on tumor growth has been convincingly demonstrated by Lewisohn (*2*) and his collaborators in experimental animals.

An aqueous extract of calf's spleen has been prepared by the senior author and employed clinically by him for more than 18 years. He reported in 1929 (*3*) that two cases of Hodgkin's lesions (with and without previous X-ray therapy) showed decrease in size and softening of the nodes, but that results on other malignant growths were not encouraging. However, with improvement of techniques of extraction he has prepared a much more effective product which has been employed with decided clinical benefit, and two patients have a history of 12–13 years survival. A report of these clinical findings will be published elsewhere.

This same extract injected into mice bearing transplanted sarcoma 37 or methylcholanthrene-induced primary sarcoma produced cellular changes of a striking nature. Three concentrations were employed: "low" (8.0 grams of spleen solids/100 cc.), "medium" (15.5 grams/100 cc.) and "high" (26.5 grams/100 cc.). The difference between low and medium concentrations is merely one of an additional step in filtration. Resorption of both primary and implanted tumors was obtained, varying in percentage with the size of the tumor treated, the concentration of the extract, and the injection route employed. The best results were obtained with the medium concentration injected intraperitoneally three times daily (total daily dose, 1 cc.). The high concentration was toxic, even when injected subcutaneously; the low concentration appeared to stimulate growth. With the medium concentration, growth inhibition could be detected as early as 18 hours after the first intraperitoneal injection, and it was not necessary to resort to injection by the intravenous route. As early as 48 hours, at which time mice with transplanted tumors had received intraperitoneally 1.8 cc. of the medium concentration, almost complete degeneration of tumor cells was microscopically demonstrable. Nuclei had disappeared completely, leaving structurally intact only the cell body filled with small vacuoles. Similar phenomena were produced in about 5 days in small (5-mm. diameter), chemically induced tumors whose hosts received a total of 3.0 cc. of medium concentration spleen extract intraperitoneally. These tumors were characterized by fragmentation of nuclei and aberrant staining. With the low concentration, nuclei became greatly swollen by the end of the second day after initial injection, and this was a forerunner of increased mitotic activity. Tumors so treated grew rapidly, surpassing the dimensions of the controls. With all of the concentrations, mitosis was uninhibited as long as any viable tissue persisted. The destructive agent does not appear, therefore, to be a mitotic poison.

In Hahnemann Medical College and Hospital, three patients with malignancy and metastases (one metastatic hypernephroma and two metastatic bronchogenic carcinomas) have been injected with the Watson spleen extract (medium concentration) intravenously and intramuscularly, twice daily for 12 weeks—a total daily dose of 5–6 cc. There is definite improvement in the general health of all these patients and inhibition of progress of their tumors as revealed by Roentgen studies, made at regular intervals. Detailed clinical findings will be reported at a later date.

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IN THE LABORATORY

Stereotaxic Apparatus for Operations on the Human Brain[1]

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Exposure of subcortical areas usually necessitates rather extensive operations. It seemed desirable, therefore, to adapt the stereotaxic technic for use on the human brain. This technic, employed thus far for animal experimentation only (*1*), permits one to insert a wire or a cannula accurately into a desired subcortical area with minimal injury to the cerebral cortex or the white matter.

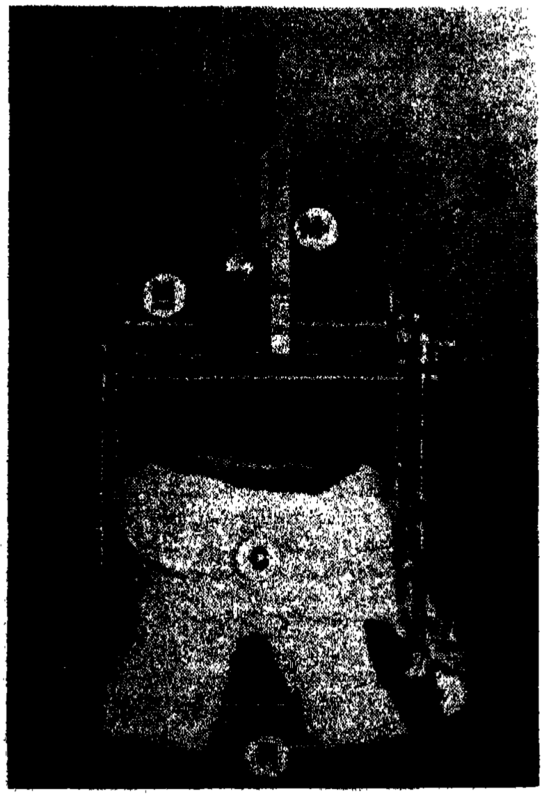

Fig. 1. Side view of stereotaxic apparatus: R = ring; C = cast of plaster of Paris; M· = millimeter scale on needle holder; $\underline{M}$ = millimeter scale for movement in sagittal direction.

Our apparatus (Figs. 1 and 2) consists of a ring (R) fixed to the skull by means of a cap of plaster of Paris (C) and a frame resting upon the ring and carrying the wire or cannula to be introduced into the brain.

The needle holder can be moved in sagittal as well as lateral directions and lowered toward the base of the skull in a direction perpendicular to the horizontal plane of the skull or, with the needle holder tilted in the frontal or sagittal plane, at other angles to the horizontal plane. The exact position of the needle in relation to the coordinates of the skull is easily determined by the millimeter scales (M·, $\underline{M}$, M′), and the angle between needle and horizontal plane by the scales on the protractors (P′, P″).

The preoperative preparation and operative procedure consist of the following steps:

(1) A plaster cast is prepared which fastens the ring rigidly to the shaved head in the proper position, *i.e.* parallel to the horizontal plane (determined by the inferior margin of the orbit and the upper border of the external auditory meatus on either side). After the cast has hardened, large windows are cut in its top (field of operation) and in the frontal and temporoparietal regions (for X-ray photography of the pineal body and of the region of the thalamus). It is important that the ring with the cast can be easily removed from the skull and reapplied during operation in exactly the same position as before operation.

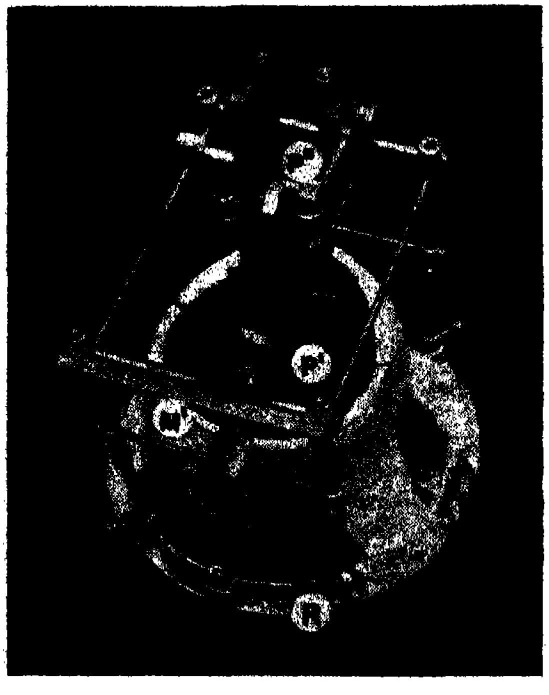

Fig. 2. Apparatus seen from above: M′ = millimeter scale for movement in lateral direction; P′ = protractor for tilting needle holder in frontal plane; P″ = protractor (on back of needle holder) for tilting needle in sagittal plane; R = ring.

(2) An X-ray picture is taken with the apparatus in situ

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and the needle in the zero position (crossing of the interaural and midsagittal planes) before and after filling of the ventricles with air. From these photographs the coordinates of the lesion are calculated and the place of trepanation is determined.

(3) After trepanation a wire or cannula is introduced through the intact dura, a lesion is produced by thermocoagulation, fluids are aspirated or injected, etc.

This apparatus is being used for psychosurgery. In a series of patients studied in collaboration with H. Freed, lesions have been placed in the region of the medial nucleus of the thalamus (medial thalamotomy) in order to reduce the emotional reactivity by a procedure much less drastic than frontal lobotomy (*2*). The results so far obtained are promising. Further applications of the stereotaxic technic are under study, e.g. interruption of the spinothalamic tract in certain types of pain or phantom limb; production of pallidal lesions in involuntary movements; electrocoagulation of the Gasserian ganglion in trigeminal neuralgia; and withdrawal of fluid from pathological cavities, cystic tumors.

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A Solution for Plasticizing Kymograph Records

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In the past, many solutions such as shellac in ethanol, resin in ethanol or isopropanol, etc. have been used to fix kymograph records. Satisfactory results were not always obtained because, as the solutions became more concentrated due to evaporation, the records were extremely sticky, did not dry rapidly, and had a glossy finish which would not photograph readily.

The solution to be described has been used for 8 months and has always given excellent results in that the records dried within 10 minutes, were never sticky, and always had a dull finish. One further advantage was the ease with which the fixing pan was cleaned. A 10 per cent aqueous solution of sodium carbonate readily removes all traces of the dried fixative from the pan.

The plasticizing solution is composed of cellulose acetate phthalate (Eastman Kodak Co.), 10 grams; ethyl lactate, 150 cc.; ethyl acetate, 150 cc.; and ethanol or isopropanol, 700 cc. To prevent precipitation of the plastic, the solution must be mixed in the following manner: dissolve the cellulose acetate phthalate in 25 cc. of ethyl lactate and then add an equal quantity of ethyl acetate. This solution is added to half of the ethanol or isopropanol with rapid stirring. Some precipitation of the plastic may occur at this point, but the addition of another 25 cc. each of ethyl lactate and acetate will redissolve the precipitate. Add the remainder of the alcohol, ethyl lactate, and ethyl acetate in that order. Filter the solution by gravity through glass wool and bottle. Kymograph records are fixed in the usual manner with this finished solution.

Yeast Autolysate: A Culture Medium for *Hemophilus influenzae*

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It is generally agreed that *H. influenzae* requires for its growth two distinct factors, the heat-labile V factor and the heat-stabile X factor. Lwoff and Lwoff (*5*) have shown that the V factor is a coenzyme, and their observation has been confirmed by other investigators. Gingrich and Schlenk (*3*) reported that codehydrogenase I replaces the V factor and, in this respect, is superior to codehydrogenase II. The X factor can be replaced by crystalline beef-liver catalase according to Bass, Berkman, Saunders, and Koser (*1*). From the investigations of Hoagland and associates (*4*) as well as of Bass and co-workers (*1*) it is evident that in addition to these two growth factors other compounds may be required for maximal growth. Yeast is known to be rich in V factor; however, it is generally regarded to be lacking in X factor. The experiments reported below revealed that yeast autolysate supplies both growth factors required by *H. influenzae* and suggest that this substrate may be used to advantage as a culture medium and may be useful in studies on the streptomycin sensitivity of this microorganism.

The yeast autolysate (Supplement B) used in these studies was procured from Difco Laboratories. It is a filtrate of autolyzed fresh yeast and, according to Schoenlein (*6*), is rich in coenzyme, glutamine, cocarboxylase, and other B-vitamin factors. Difco Supplement is recommended for use in the cultivation of *Neisseria gonorrhoeae* and has been employed by Buck (*2*). In the present study, two lots (#388386 and #388624) proved to be equally satisfactory. For as yet unexplained reasons another lot (#386207) failed to support the growth of *H. influenzae*. The vast majority of experiments were carried out with lot #388386.

Nineteen strains of *H. influenzae* were used. Six strains were freshly isolated from the spinal fluid of patients with meningitis; the remainder were stock culture strains available in this laboratory or kindly supplied by H. E. Alexander and the Division of Laboratories and Research, New York State Department of Health. Seventeen strains belong to type b and one strain each to types a and c, respectively.

The first series of experiments was undertaken to determine the growth-promoting properties of yeast autolysate. The 19 strains of *H. influenzae* were seeded into 10 per cent yeast autolysate-brain heart infusion. All grew profusely within 24 hours in this culture medium and failed to grow entirely in brain heart infusion used as control. In view of the fact that the inoculum, which was harvested from hemoglobin-proteose peptone #3 agar, may have contained an adequate amount of X factor, serial transfers were made daily from yeast autolysate-brain heart infusion to yeast autolysate-brain heart infusion. Each transfer resulted in a dilution of 1:10. It was found that all strains could be maintained in this culture medium for 15 consecutive subcultures. It is noteworthy that the organisms maintained their type-specificity: specific soluble substance could be demonstrated by means of type-specific antiserum. Moreover, no changes were noted in the morphological and cultural characteristics of the organisms throughout this experiment in films and colony formation on hemoglobin-proteose #3 agar. It may be concluded, therefore, that yeast autolysate in brain heart infusion supplies the essential growth factors required by *H. influenzae*.

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[1] The author wishes to acknowledge the technical assistance of C. F. Crotty.

The growth-promoting properties of yeast autolysate in different concentrations were then studied. A strain of *H. influenzae* type b, which had been maintained in yeast autolysate-brain heart infusion for 12 consecutive subcultures, was used as inoculum of brain heart infusion containing yeast autolysate in concentrations ranging from 0.01 to 10 per cent. The seeded culture media were incubated at 37°C. The results of this experiment are summarized in Table 1.

TABLE 1

GROWTH OF *H. influenzae* TYPE b AND PRODUCTION OF SSS IN BRAIN HEART INFUSION CONTAINING YEAST AUTOLYSATE

Hours of incubation	Concentration of yeast autolysate (%) 10	1	0.1	0.01	0
	Growth				
18	++++	++++	++	+	−
48	++++	+++	+	−	−
72	++++	+++	+	−	−
	Presence of SSS				
72	++++	++++	+++	+	−

− = no growth, no SSS; + to ++++ = various degrees of visible growth and various amounts of SSS.

It may be seen that *H. influenzae* grew profusely within 24 hours in infusion containing 1 and 10 per cent yeast autolysate while lower concentrations promoted only slight growth. Attention may be called to the fact that the strain produced type-specific substance. Similar results were obtained with several other strains of *H. influenzae*. Yeast autolysate in a concentration of 50 per cent either failed to promote growth or did so more slowly and to a lesser degree than that used in a concentration of 10 per cent.

In order to assay quantitatively the growth of *H. influenzae* in yeast autolysate-brain heart infusion, the following studies were undertaken. A strain of *H. influenzae* type b was grown in 10 per cent yeast autolysate-brain heart infusion for 24 hours. Serial dilutions (from 10^{-1} to 10^{-11}) were then prepared and used for seeding of the same culture medium. In this fashion the smallest inoculum promoting visible growth was determined. It was found that growth was obtained with inocula in dilutions up to 10^{-9}. Similar titrations carried out with other strains revealed that cultures of *H. influenzae* could be diluted from 10^{-8} to 10^{-11} and still promote growth, when used for inoculation of the 10 per cent yeast autolysate-brain heart infusion. Freshly prepared pipettes were used for each dilution. Even so, this method of titration by necessity has only limited accuracy. From the data just presented it appears to be safe to conclude that type b showed at least a 10,000,000- to 100,000,000-fold increase in this culture medium.

Preliminary studies on the comparative efficacy of yeast autolysate-brain heart infusion and hemoglobin-proteose #3 agar (Difco) revealed that growth may be obtained more rapidly in the fluid than on the solid medium, particularly if small inocula are used for seeding purposes. It appears, therefore, that the yeast autolysate medium may be superior under certain conditions to the presently employed hemoglobin-proteose #3 agar. Moreover, incubation under increased CO_2 pressure is unnecessary.

In order to elucidate the question of whether the X factor is supplied by the yeast autolysate or by the brain heart infusion, 10 strains of *H. influenzae* were seeded into 10 per cent yeast autolysate-saline solution. All strains grew within 24 hours and could be maintained in this medium for 18 consecutive transfers. Since each transfer resulted in a dilution of 1:10, it seems safe to assume that X factor, which may have been present in the first inoculum, was no longer left at the end of the experiment. Therefore, yeast autolysate fulfills the growth requirements of *H. influenzae*. It seems of interest to point out that all type b strains tested produced the type-specific substance in this medium.

Yeast autolysate alone does not permit maximal growth of *H. influenzae*. This conclusion is based on the following observations: (1) A larger inoculum is necessary in order to promote growth in 10 per cent yeast autolysate-saline solution than in 10 per cent yeast autolysate-brain heart infusion. In several experiments the respective inocula were 10^{-3} for yeast autolysate alone and less than 10^{-6} for yeast autolysate-brain heart infusion. (2) Growth in yeast autolysate-saline solution usually is somewhat less profuse and takes place more slowly than in yeast autolysate-brain heart infusion.

On the basis of the foregoing data yeast autolysate appears to be a suitable medium for the growth of *H. influenzae*, and it seems possible that this material may be used to advantage in cultural examinations. Preliminary to such studies, experiments were carried out on the growth-promoting properties of yeast autolysate in spinal fluid procured under aseptic conditions from patients free of meningitis. Both cell count and protein content were within normal limits. It could be shown that *H. influenzae* type b grows well in 10 per cent yeast autolysate-spinal fluid and produces the type-specific soluble substance. One strain was maintained in this medium for 19 serial transfers. That yeast autolysate, indeed, may be of aid in the diagnosis of meningitis caused by *H. influenzae* is suggested by the following observation: Identical amounts of spinal fluid (no microorganisms seen on film) from a patient with clinical meningitis were seeded on hemoglobin-proteose #3 agar, blood agar, and into 10 per cent yeast autolysate-brain heart infusion. After incubation at 37°C. for 18 hours profuse cloudiness was present in the yeast autolysate medium, whereas only minute colonies were seen on the solid culture media. Anti-*H. influenzae* type b serum produced specific precipitation and/or agglutination with the yeast autolysate culture.

Determination of the sensitivity to streptomycin of strains of *H. influenzae* isolated from patients prior to, and concurrent with, chemotherapy is of practical importance. It was decided, therefore, to investigate the possible usefulness of yeast autolysate as a culture medium for such tests. Thus far 12 strains have been studied in this medium, using streptomycin in amounts of 1 and 10 μg./ml. The results of a representative experiment are summarized in Table 2.

It is evident that streptomycin prevents or inhibits the growth of the organism. Attention may be called to the fact that the size of the inoculum influences the degree of bacteriostasis. All 12 strains tested were inhibited by streptomycin in amounts ranging between 1 and 10 μg./ml. This finding corresponds closely to the results obtained on solid culture media: *H. influenzae* is inhibited by 5 μg./ml. of agar. Using yeast autolysate as the culture medium, the results may be obtained within 18 hours. Furthermore, it appears from the data presented above that such a test can be carried out even if only small numbers or organisms are available for the inoculation of the yeast autolysate medium.

TABLE 2

Bacteriostatic Effects of Streptomycin Upon *H. influenzae* Type b in 10 Per Cent Yeast Autolysate-Brain Heart Infusion

Hours of observation	Streptomycin 10 μg./ml.	 1 μg./ml.	 0 μg./ml.
	Inoculum 0.2 ml. of undiluted culture		
18	−	++++	++++
24	−	++++	++++
48	−	++++	++++
	Inoculum 0.2 ml. of 1:100 diluted culture		
18	−	++++	++++
24	−	++++	++++
48	−	++++	++++
	Inoculum 0.2 ml. of 1:10,000 diluted culture		
18	−	+	++++
24	−	++	++++
48	−	++++	++++
	Inoculum 0.2 ml. of 1:1,000,000 diluted culture		
18	−	−	++++
24	−	−	++++
48	−	−	++++

− = no visible growth; + to ++++ = various degrees of visible growth.

The experiments presented revealed that yeast autolysate contains the essential growth factors required by *H. influenzae*. All strains tested thus far could be grown and maintained both in 10 per cent yeast autolysate-saline solution and in yeast autolysate-brain heart infusion. It is worthy of note that these culture media promote rapid multiplication of the organism and that the resulting growth causes grossly visible cloudiness. This observation seems to be of significance, since, as stated by Hoagland and his associates (*4*) in 1942, "turbidity produced by growth of *H. influenzae* is rarely great, even under optimum conditions." The question remains as to the nature of the X factor present in yeast autolysate. Studies are needed to determine whether this material contains a factor identical with, or similar to, the active component in hemin or whether some other substance such as catalase acts as X factor.

From a practical point of view the demonstration of the growth-promoting properties of yeast autolysate may find several applications. It seems quite possible that yeast autolysate infusion broth may be used to advantage for the growth of *H. influenzae*, particularly for the isolation of this organism from spinal fluid, blood, pus, etc. Preliminary studies indicate that growth may be obtained in the yeast autolysate medium more rapidly and with smaller inocula than on hemoglobin-proteose #3 agar. It is worthy of note that all type b strains grown in yeast autolysate produced the type-specific soluble substance. Studies are indicated, therefore, to determine quantitatively the amount of SSS formed in this culture medium. Such a study may yield information on the potential value of yeast autolysate cultures as immunizing antigens used in rabbits, a procedure which may be employed for the production of therapeutically effective antiserum. It has been shown, furthermore, that yeast autolysate-brain heart infusion can be used in tests designed to determine the streptomycin sensitivity of strains of *H. influenzae*.

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A Simple Method for Changing Units

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Students and research workers frequently experience difficulty in converting a quantity from one system of units to another. The following rule, which the writer has used in his classes for several years, eliminates the uncertainty in such computations by reducing them to a routine procedure.

Rule: *Write the quantity with its units in the first system. Give to each unit the coefficient 1. Substitute for each of these units its value in the second system. Reduce all numerical factors to a single coefficient, which is the numerical value of the quantity in the second system of units.*

Example: Given, the coefficient of thermal conductivity of glass:

$$k = 0.00250\,\frac{\text{cal. cm.}}{\text{cm.}^2\ {}^\circ\text{C. sec.}}\,.$$

Required, k in terms of B.t.u. per in. thickness per ft.² per °F. per hr.

Applying the rule,

$$k = 0.00250\,\frac{[1\ \text{cal.}]\,[1\ \text{cm.}]}{[1\ \text{cm.}^2]\,[1^\circ\text{C.}]\,[1\ \text{sec.}]}$$

$$= 0.00250\,\frac{\left[\dfrac{1}{252}\,\text{B.t.u.}\right]\left[\dfrac{1}{2.54}\,\text{in.}\right]}{\left[\dfrac{1}{30.48}\,\text{ft.}\right]^2\left[\dfrac{9}{5}\,{}^\circ\text{F.}\right]\left[\dfrac{1}{3{,}600}\,\text{hr.}\right]}$$

$$= 7.26\,\frac{\text{B.t.u. in.}}{\text{ft.}^2\ {}^\circ\text{F. hr.}}\,.$$

A Hot-Air Apparatus Dryer for General Laboratory Use[1]

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A survey of the literature shows that a number of workers have felt the need of a good, quick method of drying glass apparatus (*1*). However, all of these dryers either have been designed for a special purpose or require some unusual techniques for building them. The design of an air dryer for general laboratory use should take into account the following requirements:

(1) It should be constructed of easily available, commercial materials of standard design, so that construction and replacement of parts is not a burden.

(2) It should fit well into the common arrangement of laboratory utilities.

(3) It should be equipped with sufficient protective devices so that the usual errors in use will not result in breakdown of the equipment.

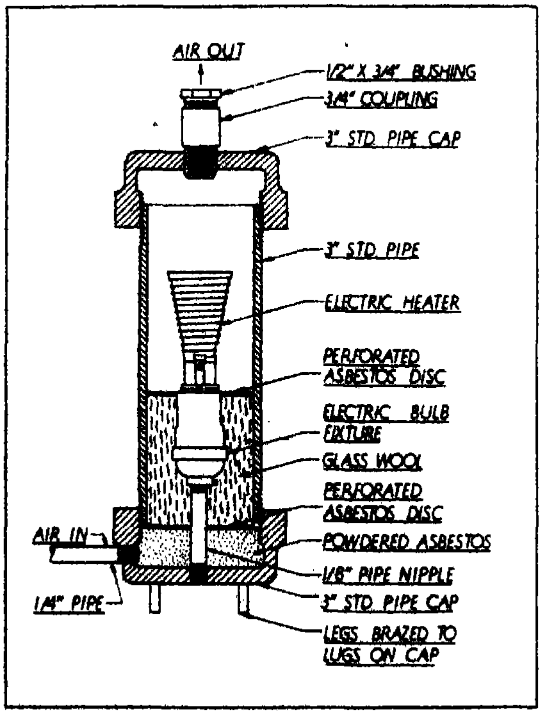

FIG. 1

The design of the equipment reported here, which has been in use in all of the student laboratories at Antioch College for the past three years, fulfills these requirements.

The air heater (Fig. 1) has an over-all height of 24 inches and should be placed at the end of a laboratory table where it can be connected directly to the utility lines that generally run through uprights, down the middle or at the back of the table. The compressed-air line is connected to the heater through a steam valve which offers easy regulation of the pressure. The electrical connection should be made with asbestos-covered wire, and the electric fixture should be porcelain to prevent a short circuit if the heater is accidentally left on without air flowing through it. The connection to the electrical utility source should be made through a standard switch box containing a safety light to show when the heater is on. The asbestos and glass-wool packing may be omitted if the air line is free from oil. When the threaded caps are not tightened to the pipe which forms the body of the heater, they are easily removed for replacement of the heating coil or packing. The unit is painted with aluminum paint or heat-resistant lacquer to prevent rusting in the usual laboratory atmosphere.

The apparatus to be dried is inverted and hung on a tubular, glass or metal support which is inserted into the coupling at the top of the heater. Although glass supports are subject to breakage, they may be made with little trouble to fit special types of drying problems and are not a source of contamination when kept clean. Metal supports may be used when special types of contamination are not objectionable. The supports are fitted to the heater by expanding the tubing over a narrow area so that it just slips inside the coupling at the top with the expanded portion resting on the nipple and a short unexpanded length extending through the nipple into the heater. The bushing is then dropped over the support and tightened until it rests firmly on the expanded portion. When glass is used, the expanded portion should be protected from the raw metal surfaces by asbestos cord.

Fig. 2 shows two designs of tubular, pyrex glass supports that have been used with success. Design A, made from 10-mm. standard-wall glass, was used for larger apparatus, where considerable volume of air is needed. The bushing must be placed on the tubing before the upper end is flared. Design B, made of 5-mm. glass sealed to a 10-mm. section, allows smaller apparatus for micro and semimicro work to be dried. The sealed-off upper end kept the light pieces from being blown off the support, while the small holes in the sides furnished sufficient hot air. The length of the support may be varied at will; those used were approximately 12 inches long.

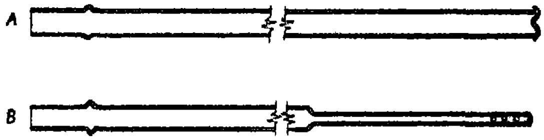

FIG. 2

The cost of this type of drying equipment is small, and it can be installed by a plumber and an electrician. Its use by students clears drying ovens, facilitates laboratory work, and allows apparatus to be returned, dry, to the stockroom. From a cold start, the time required to obtain hot air is about 40 seconds.

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[1] The author wishes to acknowledge suggestions on change of design made by R. A. Borden and E. L. Birch.

Book Reviews

Unified calculus. Edward S. Smith, Meyer Salkover, and Howard K. Justice. New York: John Wiley; London: Chapman & Hall, 1947. Pp. x + 507. $3.50.

In their effort to introduce unity into the calculus and to provide correlation with physics and mechanics, the authors have made the following noteworthy contributions: (1) the use of the $\frac{dy}{dx}$ notation for the derivative from the start; (2) the interweaving of the ideas of differentiation and integration in connection with the simple polynomial functions; (3) the inclusion of applications of integration to centroids and moments of inertia with the earliest study of integration in company with the conventional applications to area, volume, liquid pressure, and work; (4) early presentation of the idea of definite integral; (5) a very clear explanation of the differential, with its applications and its relation to integration; (6) a line of choice problems on definite integrals and applications interspersed through all the chapters which deal with the formulas and methods of integration; (7) the adoption of right-handed space axes (the physicists should bless them for that!); (8) a small but adequate appendix of formulas and tables; and (9) a chapter on differential equations. While much of the text is identical with that of its excellent predecessor, there are many simplifications and clarifications which will please discriminating students and teachers. The typography is excellent, the cuts are clear and suggestive, and the somewhat smaller format which grew out of the necessity of paper conservation has not impaired the excellence of the presentation but should make the text look a little less formidable to the student. The reviewer is anxious to give it a first-hand working over with his classes this fall.

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The chemical kinetics of the bacterial cell. C. N. Hinshelwood. New York: Oxford Univ. Press, 1946. Pp. 284. $6.75.

Prof. Hinshelwood, who is well known for his work in chemical kinetics, has applied some of its principles to the problems of bacterial physiology and in particular to bacterial variation. The theoretical treatment is based on the assumption that the cell is, in effect, an assembly of self-duplicating units (which the author identifies with enzymes), and that the pattern of these units determines the pattern of cellular characteristics. Much of the experimental material was obtained in the author's laboratory. The possibility that the self-duplicating entities are enzyme-forming units rather than enzymes is unfortunately not considered, although this would leave many of the formal developments unchanged. The consequences of competition among different types of self-duplicating units are also ignored; this is a more serious omission with respect to the validity of the kinetic derivations.

There is an extensive discussion of mutation and selection as possible alternatives to the mechanism proposed, and of the results of combining them with this mechanism. It is a pity that the author did not clearly emphasize two important points: that the ability to adapt by a biochemical mechanism seems to require the presence of a specific gene, and that such a mechanism furnishes a key to the fundamental problem of the relation between genotype and phenotype.

It is surprising to find only one reference to the fundamental work on adaptive enzymes by Spiegelman and none to the important studies of the "killer" character by Sonneborn. Selection and the evolution of populations are discussed without reference to the contributions of Lotka, Volterra, Delbrück, and Luria. Finally, a book on the kinetics of self-duplicating units should include some mention of Darlington and Sewall Wright, who first called attention to the importance of such units for physiological genetics.

With regard to some of the experimental material cited, it is regrettable that adaptation to carbohydrates was studied by the awkward method of growth and lag measurements rather than the well-known direct biochemical procedures. Despite these criticisms, this book must be regarded as required reading for the general microbiologist and the theoretical biologist.

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The technology of adhesives. John Delmonte. New York Reinhold, 1947. Pp. viii + 516. (Illustrated.) $8.00.

The development of plastics has revolutionized adhesive technology and has broadened its usefulness into many new fields of applications which were previously either unknown or were handled by entirely different techniques. This widened industrial scope presents a complicated and often confused picture to the adhesive consumer, making it difficult to select critically the proper adhesive for a specific application.

This book, divided into 20 chapters covering all the main classes of synthetic resins as well as other well-known types of adhesives, should do much to clear up this situation. There are also chapters on the theories of adhesive action and their application to important classes of materials such as wood, organic plastics, metal, rubber, paper, textiles, and inorganic materials; tests and specifications are also described. After each chapter is a list of references, mostly to patents; much of the technical information in the text appears to be taken from patent teachings without any indication as to whether the patent claims have been substantiated by the author.

There are very few illustrations for the size of the book. More pictures demonstrating gluing equipment, techniques, and important applications would be of considerable aid to readers with little experience in the field.

The book is well written and well organized and should be very helpful to anyone connected with bonding problems in any way. It would be a valuable refresher and reference work for the expert and also serve as an up-to-date treatise for both the fabricator and layman.

J. M. GRIM

Mellon Institute for Industrial Research

The Polysulfides in Levinstein Process Mustard Gas

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IN WORLD WAR I THE GERMANS HAD THE facilities and materials available to prepare mustard gas by a relatively simple process from thiodiglycol and hydrochloric acid:

$$\underset{\text{Thiodiglycol (TG)}}{HOCH_2CH_2SCH_2CH_2OH} + 2HCl \rightarrow \underset{\text{Mustard Gas (H)}}{ClCH_2CH_2SCH_2CH_2Cl} + 2H_2O. \qquad (1)$$

The product of this reaction is referred to in this country as TGH, the symbol H representing mustard gas, bis(β-chloroethyl)sulfide. The materials for this process were not available to the Allies in World War I, but by brilliant teamwork the British and Americans rapidly developed the so-called Levinstein process (named after the British drug manufacturer), the product of which is known as Levinstein H. The method consists in reacting ethylene and sulfur monochloride; the stoichiometry of the reaction is usually written as follows:

$$CH_2 = CH_2 + S_2Cl_2 \rightarrow ClCH_2CH_2SCH_2CH_2Cl + S. \quad (2)$$

When the reaction is allowed to run at about 60°, most of the excess sulfur indicated by this equation precipitates rapidly. If the reaction temperature is held to 35–38°, however, the "excess" sulfur atom does not begin to precipitate until the product has been stored for at least a few weeks. These processes for making TGH and Levinstein H have been reviewed by Sartori (*11*).

The mechanism of the Levinstein process was well understood by Conant (see Sartori, p. 218), but a more complete explanation has recently been found by a research group working at the University of Illinois under Fuson (*6*).

The behavior of the extra sulfur atom in Levinstein H was somewhat of a mystery from World War I to World War II. For a long time it was supposed that the "excess" sulfur was in colloidal suspension, because, as it precipitated, there was very little change in freezing point. Somewhat fanciful suggestions were sometimes offered as to the nature of this colloidal system. The literature, however, does contain suggestions to the effect that the sulfur atom is in chemical combination. For example, Conant, *et al.* (*3*) proposed that part of the sulfur is in the free state, probably colloidal, and the rest in combination as a pentasulfide $(ClCH_2CH_2)S_5$. This suggestion of the presence of a pentasulfide was based on the analysis of the residue from distillation of a sample of Levinstein H. Bennett (*2*) prepared the disulfide $(ClCH_2CH_2)_2S_2$, and Mann, Pope, and Vernon (*9*) isolated a trisulfide $(ClCH_2CH_2)_2S_3$. (The polysulfides will be referred to in this paper as HS_2 for the disulfide, HS_3 for the trisulfide, etc.)

It is the purpose of this paper to review briefly the part played by Edgewood Arsenal personnel in the elucidation of the mystery of Levinstein H. In order to assist in the interpretation of this work, data are shown (Table 1) which illustrate the nature of Levinstein H as manufactured in steel reactors on a large scale. The composition of a sample is generally determined by distillation under certain specified conditions, with the still-pot at 150° C. under a pressure of about 5 mm. Samples stored in steel containers increase in iron content at a more or less rapid rate.

TABLE 1

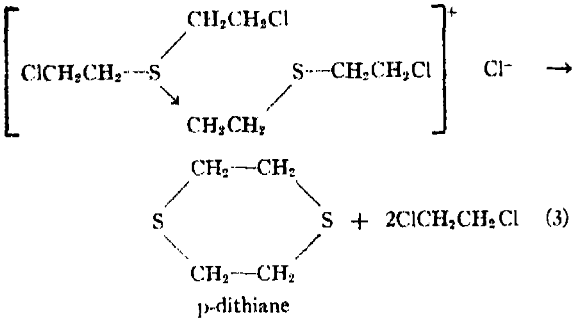
REPRESENTATIVE ANALYSES OF LEVINSTEIN H SAMPLES

	New sample	Aged sample
Acidity (as HCl), %	0.16	0.38
Iron (as $FeCl_3$), %	0.22	0.41
Melting point, °C.	7.7	7.6
Density at 20°C., grams/cc.	1.351	1.340
Sulfur, %	33.46	30.70
Chlorine, %	36.35	38.42
Distillation analysis:		
Distillate, %	78.3	76.2
Residue, %	20.7	22.1
Loss, %	1.0	1.7
M.P. of distillate, °C.	10.2	12.1
Purity of distillate*, %	88.5	93.8
Mustard content, %	69.3	71.5

* Calculated from melting point, assuming that pure H melts at 14.4° C.

Contribution of Jarman and Morrison (*7*): The pure H content of newly made Levinstein H lies in the range of 68–73 per cent by weight. The residue remaining after the distillation of a sample of Levinstein H was fractionally distilled in a 12-plate column; it yielded a fraction of pure H, a quantity of HS_2, and some p-dithiane, which condensed in the column. The presence of p-dithiane is probably due to decomposition in the still-pot of sulfonium salts which are formed by polymerization of H, as indicated in Equation 3.

$$2ClCH_2CH_2—S—CH_2CH_2Cl \rightleftarrows$$



(3)

A decomposition of this nature at elevated temperature to give higher homologs of straight-chain thioethers rather than a cyclic compound was recently described by Snyder, *et al.* (*12*), but the mechanism for decompositions of both types was described in 1927 by Bell, Bennett, and Hock (*1*).

In order to eliminate still-pot decomposition as much as possible, several distillations of Levinstein H were made at ordinary temperatures in a molecular still of the type described by Detwiler and Markley (*4*). In one experiment the residue was separated into two fractions by extraction with acetone. Analyses of the fractions gave compositions approximating the formulas HS_4 (acetone soluble) and HS_{12} (acetone insoluble). The acetone-soluble fraction, when passed through the molecular still, gave a distillate which contained a considerable proportion of HS_2 and a residue with the approximate composition $HS_{4.5}$.

Another sample of whole Levinstein H, when molecularly distilled, gave a residue which separated into two layers of the following compositions:

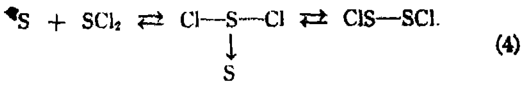
	%S	%Cl	Approximate composition
Upper layer	51.89	25.27	$HS_{4.3}$
Lower "	28.21	36.96	$HS_{1.7}$

It has long been known (*5*) that ammonia tends to throw down nearly half of the "excess" sulfur shown in Equation 2. A residue remaining after a molecular distillation of Levinstein H was analyzed before and after such an ammonia-stripping treatment, as shown below. The sulfur precipitate, washed with benzene, acetone, 20 per cent HCl, and water, contained 98.46 per cent sulfur and 0.07 per cent chlorine, by analysis.

	%S	%Cl	Approximate composition
Residue before ammoniation	59.20	22.45	HS_4
Residue after ammoniation	52.44	25.55	$HS_{4.4}$

Some exploratory work on the synthesis of HS_2 and HS_4 was done, but work on this project by these investigators was halted before it was completed. The principal conclusion drawn was that labile polysulfides constitute the major impurities in Levinstein H. They are in a state of constant dynamic flux, based upon the probable property of the linear —C—S—S—C— linkage to acquire and relinquish additional sulfur atoms or molecules under a variety of conditions.

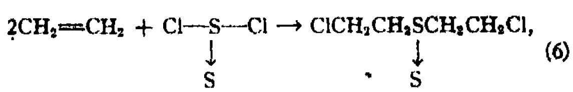
Contribution of E. Emmet Reid (*10*): Sulfur monochloride is generally accepted to be an equilibrium mixture in which the following species, at least, are said to be present:



$$S + SCl_2 \rightleftarrows Cl—\underset{\downarrow\atop S}{S}—Cl \rightleftarrows ClS—SCl. \qquad (4)$$

Ethylene may react to all of these:

$$2CH_2{=\!=}CH_2 + SCl_2 \rightarrow ClCH_2CH_2SCH_2CH_2Cl, \qquad (5)$$

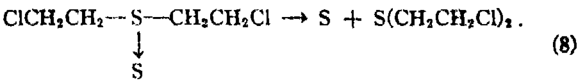


$$2CH_2{=\!=}CH_2 + Cl—\underset{\downarrow\atop S}{S}—Cl \rightarrow ClCH_2CH_2\underset{\downarrow\atop S}{S}CH_2CH_2Cl, \qquad (6)$$

$$2CH_2{=\!=}CH_2 + ClS—SCl \rightarrow ClCH_2CH_2S—SCH_2CH_2Cl. \qquad (7)$$

Possible intermediate compounds are left out. There is also the possible addition of sulfur to ethylene to give ethylene sulfide, which is known to take place at a higher temperature.

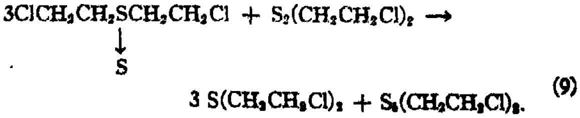
The reaction product shown in Equation 6 is hypothetical, though its formation is probable. This would give off sulfur:



$$ClCH_2CH_2—\underset{\downarrow\atop S}{S}—CH_2CH_2Cl \rightarrow S + S(CH_2CH_2Cl)_2. \qquad (8)$$

No disulfide of the composition $R—\underset{\downarrow\atop S}{S}—R$ is known, but disulfides RS—SR are well known. These take up sulfur to form polysulfides R_2S_3, R_2S_4, and R_2S_5, and the extra sulfur can be taken from them down to the disulfide.

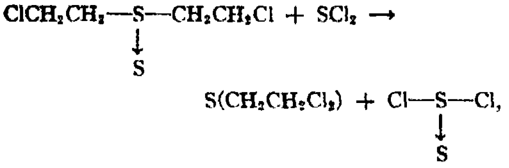
Assuming the Levinstein H to be originally a mixture of the products shown in Equations 6 and 7, we find a compound that gives up sulfur and one that takes up sulfur. Transfer of the S atom would give H and HS_3 if the two forms of HS_2 were originally in equimolecular proportions. If the ratio were different, the resulting polysulfide would be different; for example:



$$3ClCH_2CH_2\underset{\downarrow\atop S}{S}CH_2CH_2Cl + S_2(CH_2CH_2Cl)_2 \rightarrow 3\,S(CH_2CH_2Cl)_2 + S_5(CH_2CH_2Cl)_2. \qquad (9)$$

If the ratio $Cl—\underset{\downarrow\atop S}{S}—Cl$ to ClS—SCl can be altered to give a higher percentage of the former, more H should be formed and there would be more sulfur given off than could be taken up by the disulfide $ClCH_2CH_2S—SCH_2CH_2Cl$. The excess of sulfur would probably precipitate out, as in the 60° process.

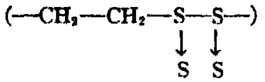
If SCl_2 can be added so that it takes the extra sulfur from the reaction product of Equation 6 in this manner,



$$\mathrm{ClCH_2CH_2}\text{—}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\text{—}\mathrm{CH_2CH_2Cl} + \mathrm{SCl_2} \rightarrow \mathrm{S(CH_2CH_2Cl_2)} + \mathrm{Cl}\text{—}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\text{—}\mathrm{Cl}, \tag{10}$$

the absorption of ethylene can continue without the formation of much of the disulfide $ClCH_2CH_2S—SCH_2CH_2Cl$, which takes up sulfur to give the pentasulfide. All of the polysulfides above the disulfide are to be considered as "statistical" compounds. The composition of a given product may correspond to R_2S_3, R_2S_4, or R_2S_5, but it may be a mixture of all of these, with some disulfide and some free sulfur.

This theory, proposed by Dr. Reid in the fall of 1942, contained the first plausible mechanism for the Levinstein process. Admittedly, it was an armchair theory based on a number of assumptions rather than on laboratory experience, but it served as a useful guide to later work (see reference to Fuson's theory, below, based on a study of the reactions of HS_2). The relation between the Reid theory and the composition of Thiokol is obvious:



$$(\text{—}\mathrm{CH_2}\text{—}\mathrm{CH_2}\text{—}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\text{—}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\text{—})$$

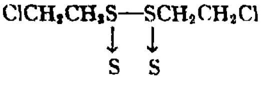
Repeating unit in Thiokol polymer

The dative-bonded sulfur atoms in Thiokol are easily removed by treatment with alkali or sodium sulfide and are easily replaced by milling with sulfur at about 70° C. Of considerable interest, also, is the recent work on the structure of ethylene polysulfides reported by personnel of the Mellon Institute (*13*), who presented experimental evidence for similar structures containing labile sulfur.

Contribution of Macy (*8*): This consisted of a study of the probable products of the reaction between ethylene and sulfur monochloride in the light of available data at Edgewood Arsenal with respect to the S and Cl contents of Levinstein H, its freezing point, and its average molecular weight. The structures of the polysulfides arrived at were influenced to a large degree by the Reid theory just described.

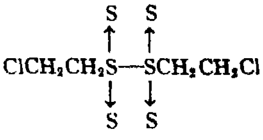
The pure H content of Levinstein H lies in the narrow range of about 68–73 per cent by weight, as already stated. The remainder consists of polysulfides. The analysis of the plant product (Table 1) gives close to 33.5 per cent S and 37.1 per cent Cl, in agreement with the stoichiometry expressed by Equation 2.

If all the "excess" sulfur indicated by Equation 2 were to precipitate, it would amount to 16.8 per cent of the total. After Levinstein H has been in storage a few weeks the deposition of sulfur usually starts, and in the course of a few months or a few years the deposit amounts to about 5–8 per cent of the weight of the initial sample. A large volume of data available, however, shows that the deposition does not proceed any further, even under treatment with chemical agents such as ammonia. For example, a sample of Levinstein H, after storage for 25 years in a steel 1-ton container, gave the following analysis: H content by distillation, 76.7 per cent; sulfur (total), 26.8 per cent; chlorine (total), 40.5 per cent. This indicated a deposit of about 6.7 per cent of sulfur in the container. It will be observed that the purity of the sample, with respect to H content, increased as the sulfur precipitated, which is to be expected (also see Table 1). In an effort to explain the composition of the resulting liquid phase, based on this analysis, it was postulated that it consisted of H and a polysulfide of the composition HS_4, the final degradation product of a polysulfide HS_6.



$$\mathrm{ClCH_2CH_2}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\text{—}\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}\mathrm{CH_2CH_2Cl}$$

HS_4



$$\mathrm{ClCH_2CH_2}\overset{\substack{\mathrm{S}\\ \uparrow}}{\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}}\text{—}\overset{\substack{\mathrm{S}\\ \uparrow}}{\underset{\substack{\downarrow\\ \mathrm{S}}}{\mathrm{S}}}\mathrm{CH_2CH_2Cl}$$

HS_6

On the basis of the H content in the above analysis, and assuming HS_4 as the principal impurity, the calculated sulfur content is 27.0 per cent, in close agreement with the experimental value. Separation of sulfur from the higher polysulfides to form the lower polysulfides would not affect the freezing point. *Constancy of freezing point was one factor which led to the original belief that the sulfur is present in colloid form.*

These considerations led to the postulate that freshly prepared Levinstein H, which contains about 70 per cent by weight of H, will also contain 30 per cent of polysulfides represented by HS_6, and that the polysulfides lose S slowly to the HS_4 level. It was also postulated that polysulfides higher than HS_6 may exist, the additional S atoms being extended as side chains on those already present in HS_6.

Support for the proposal that the polysulfides in Levinstein H are at least HS_6 was obtained by a study of available freezing point data such as are shown in Table 2. Column III gives the H content of the sample as determined by the usual distillation analysis illustrated in Table 1. In order to determine the H content more rapidly, it was at one time the practice to determine the freezing point and apply Raoult's law, $\Delta t = K N$, where Δt is the depression in freezing point; N, the mole fraction of impurity; and K, the constant for pure H (the value of which is 36.4). For a long time it was thought that the principal impurity in Levinstein H was chloroethyl chlorovinyl sulfide, the molecular weight of which is 157. The data obtained, assuming the impurity to have a molecular weight of 157, are considerably at variance with the H contents determined by distillation. In column IV the data obtained, assuming the impurity to have a molecular weight of 319 (that is, HS_6), are in quite good agreement with distillation data. The agreement of H content by distillation, and H content by freezing point, assuming the polysulfide impurity to average HS_6, is shown graphically by curve AA in Fig. 1.

TABLE 2

FREEZING POINT AND H CONTENT OF LEVINSTEIN H

I No. of runs	II Average F.P.* (°C.)	III Net H by distillation	IV Net H by F.P.†
Edgewood Arsenal Manufacture, 1918			
1	4.0	67.3	55.3
17	7.16	71.1	66.6
1	7.8	72.4	69.0
10	8.09	71.2	70.2
7	8.67	72.4	72.5
1	10.0	73.6	78.1
Edgewood Arsenal Manufacture, 1937			
1	4.25	58.7	56.2
5	6.30	65.8	63.4
9	6.76	66.9	65.1
3	7.16	67.5	66.6
1	7.82	65.3	69.0
2	8.27	67.8	70.9

* Averages of data with maximum spread of 0.5° C.

† Calculated from Raoult's law, assuming impurity with M.W. = 319.

It can be calculated from Raoult's law that a Levinstein H sample with an H content of 72.5 per cent and a freezing point of 9.05° (Fig. 1) contains an impurity with an average molecular weight of 351, which corresponds to HS_7.

The line BB of Fig. 1 is of interest in that it shows how the H content of plant samples can be determined to within a few per cent by means of the freezing point after the data have been obtained for a comparatively few samples. The lower portion of the line gives data obtained in certain tests to determine storage stability of Levinstein H in steel munitions under tropical conditions. Levinstein H decomposes fairly rapidly under these conditions, but in the first stages of the decomposition there is a rapid decrease in freezing point with relatively small decrease in H content. This indicates that the polysulfides decompose first by disproportionation. The data for the plant samples obtained in 1937 apparently fall on a line parallel to BB but displaced slightly to the left of it.

The decomposition of Levinstein H in small steel containers is remarkably rapid under tropical conditions (100–150° F.), probably due to the oxidizing nature of the sulfur in the polysulfides, $\mathrm{Fe} + \underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{S}}}\colon \rightarrow \mathrm{Fe}^{++}\ \colon\underset{\cdot\cdot}{\overset{\cdot\cdot}{\mathrm{S}}}\colon^{=}$, and subsequent reaction with ionic species in mustard similar to those indicated by Equation 3 and postulated by Bell, Bennett, and Hock (*1*). On the other hand, Levinstein H is quite stable toward aluminum, the tight aluminum sulfide coat formed by oxidation with the polysulfides apparently giving the same sort of protection that is afforded by aluminum oxide.

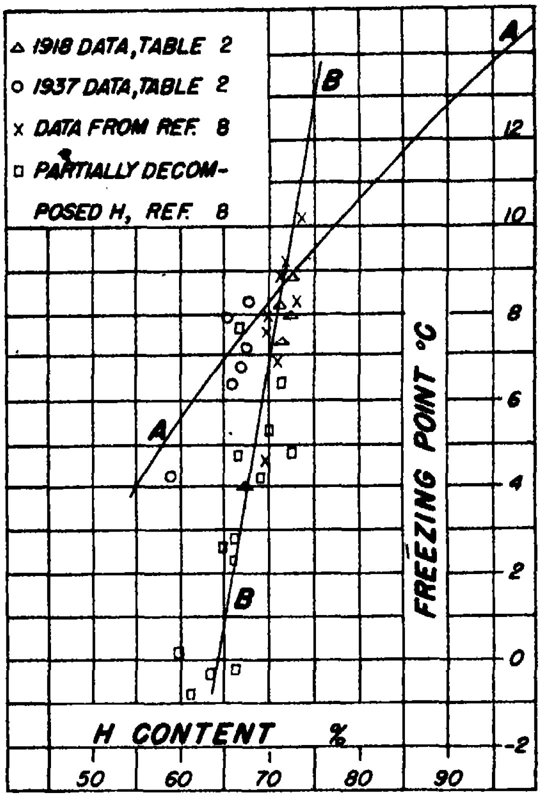
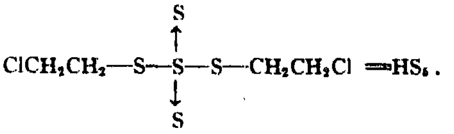


FIG. 1. Curve AA—Relation between freezing point and H content of Levinstein H according to Raoult's law for impurity with molecular weight of 319. Line BB—Freezing point and H content of plant runs of Levinstein H.

A result which at first appeared to be quite startling was the fact that, when samples of Levinstein H have decomposed in steel containers to the extent that very little pure H can be found by distillation, the material is even more vesicant than the original samples. It was suggested to Dr. Fuson at the University of Illinois, through OSRD channels, that the tarry decomposition products may contain higher homologs of mustard, which are known to be more vesicant and that the products obtained by heating mustard would be worthy of study. The result of this work was reported recently by Fuson (*6*), who found such homologs and points out that the mechanism of such decomposition by mustard had been thought out nearly 20 years ago by Bell, Bennett, and Hock (*1*).

Current status due to Fuson, et al. (*6*): The Edgewood Arsenal postulates were summarized (*8*, *10*) in June 1943. Intensive work on the isolation and properties of the polysulfides in Levinstein H was undertaken not only by Fuson's group at the University of Illinois but also by British investigators. Both sets of investigators reached the conclusion that HS_2 does not sulfurize readily (the basis of the Edgewood theory) but that HS_3 does add sulfur easily and is the structurally important unit among the polysulfides:



$$ClCH_2CH_2{-}S{-}\underset{\downarrow \atop S}{\overset{S \atop \uparrow}{S}}{-}S{-}CH_2CH_2Cl = HS_5.$$

Fuson (and British workers) assume that the —S—S—S— unit in HS_3 adds more sulfur at the central atom. The polysulfide generally present in highest concentration in Levinstein H newly made is HS_7, but all these higher polysulfides lose sulfur readily down to the stable HS_5 level with is illustrated here. This new conception is quite different from the well-known Thiokol two-in-line structure described earlier in this article.

The Edgewood theory assumed that polysulfides of H are built up on the HS_2 unit. Fuson, in experiments designed to find out how HS_2 disappears in the Levinstein process, discovered that it reacts with sulfur monochloride to yield S_3Cl_2 as a most important product. This reacts with ethylene in the Levinstein process

$$2C_2H_4 + S_3Cl_2 \rightarrow ClCH_2CH_2S_3CH_2CH_2Cl$$

and the HS_3 is sulfurized by the S_2Cl_2 present to higher polysulfides. For further details on a brilliant piece of work the reader is referred to the papers by Fuson and his associates (*6*).

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Starring in *American Men of Science*

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IN 1903 J. McKEEN CATTELL, THEN PROfessor of psychology at Columbia University and editor of *Science*, undertook to prepare a list of the 1,000 most significant living American scientists. The methods which he used were, in brief, as follows:

Ten outstanding leaders in each of 12 sciences were asked to list in order of merit the leading research scientists in their science. These 120 judges were well distributed geographically, represented several different educational institutions, and were considered to have good judgment. From their lists, Cattell worked out the average rank of each of the scientists voted upon. The number selected in each science to make up the 1,000 was approximately one-fourth of the number of such scientists then productive in America. Biographical sketches were obtained of all the scientists of 1903 judged worthy of sketching in a biographical directory. When the first *American men of science* was published in 1906, asterisks were inserted to indicate the 1,000 leaders. The directory proved so widely useful that later editions were issued in 1910, 1921, 1928, 1933, 1938, and 1944. These successive editions contained an increasing number of sketches—approximately 4,000, 5,500, 9,500, 13,500, 22,000, and 34,000, respectively.

For the second edition, voting on starring was done by all living starred scientists who would cooperate. For subsequent editions, all those nominated by a number of persons as meriting starring also were asked to vote.

The decision as to which fields of work were to be recognized by the starring of leaders was made personally by Cattell. He chose anatomy, anthropology, astronomy, botany, chemistry, geology, mathematics, pathology, physics, physiology, psychology, and zoology. Thus, even the most eminent workers in other fields were not eligible for a star. Moreover, a man who worked between well-recognized fields—in biochemistry, geophysics, or astrophysics, for example—or whose work overlapped two or more sciences, as does that of many ecologists and biologists, was rarely starred unless highly distinguished.

Another arbitrary decision made by Cattell was that few workers in applied or "practical" sciences were classed as meriting sketching in *American men of science*. This is significant because in 1903 the number of persons to be starred in any field was, it will be recalled, approximately one-fourth of the number judged worthy of a sketch in the directory.

An especially significant decision by Cattell was that during his lifetime (he died in 1944) no change should be made in the system of starring after the third edition, and that new stars should be added only in such numbers as to preserve the percentages assigned to each science in 1903. Thus, there was no adjustment to the differential growth of the several sciences. Because the number of scientists grew much more rapidly than the number of stars allowed, the proportion of scientists starred has decreased rapidly. (One thousand were starred in 1903 and approximately 250 for each later edition except the third (1921), in which 351 were starred.) For example, in 1943 about 34,000 scientists were judged worthy of sketching, but only 256 were newly starred, or approximately 1/32 as many as there were scientists newly sketched in *American men of science* since the previous starring. The total number of scientists newly starred in the fourth to seventh editions, inclusive, was about 1,000, or only 1/25 of the number who attained in those years sufficient scientific standing to be judged worthy of sketching.

In brief, while in 1903 about one-fourth of the scientists were starred, in 1943 fewer than 1/25 of those who were not elderly were starred. In some fields—chemistry, for example—less than 2 per cent of the research workers under age 60 were starred, as against about 25 per cent in 1903.

Another unfortunate consequence of using almost the same basis for starring for nearly 40 years resulted from the multiplication of scientific publications. Because of the much greater output and specialization, few men are now competent to evaluate the work of any large share of the younger men in their science. Most of the 12 sciences of 1903 now have several well-separated divisions, some of which include more active research workers than the entire science had in 1903.

ON THE SIGNIFICANCE OF STARRING

Despite imperfections of methods of starring, it is considered by numerous competent men to have been a notable contribution to scientific progress. The following summary, from a study of starred psychologists (*Amer. J. Psychol.*, 1939, **52**, 278–292), is quotable in this connection:

> Cattell's inauguration of the system of starring the leading research workers in each of 12 fundamental sciences is considered by competent judges to have been a major contribution to the growth of research in America.
>
> The star indicates that, in the private opinion of his peers, the starred scientist is distinguished for research. It implies either a large volume of good work or a considerable amount of especially original work. Of course it does not imply that the work done by others is not decidedly worth-while, but merely that it has not impressed the voters as quite so worthy of approbation.
>
> The star is a recognition which not only gives the recipient satisfaction, but also increases his opportunities. It is a challenge to the recipient to continue his good work and to others who aspire to win this recognition. Vast amounts of good work have been completed as a result of this friendly rivalry. Many scientists who are not starred feel confident that they are "as good a man as . . . " and consequently set out to prove it.
>
> The good that starring does is increased by the widened knowledge as to who are starred and why. This widened knowledge not only encourages and puts the starred men more fully on their mettle, but it also attracts attention to their work and increases their opportunities for further research. It, moreover, augments the opportunities of promising persons not starred in the hope that, as a consequence of encouragement and improved facilities, they will win this coveted recognition. The various universities employing starred scientists are placing increased value upon this recognition as a proof of individual merit and institutional strength. They not only attempt to retain and attract men already starred, but also to have local men not yet starred win this high honor; to this end they often increase facilities and otherwise encourage their more promising men.

Among the 770 starred scientists whose replies to a recent questionnaire expressed opinions as to the influence of the star on their own careers, nearly three-fourths reported that the star "improved their status" (231 slightly, 141 moderately, and 34 notably). Most of the 160 who reported no improvement were starred late in life. (A considerable number specifically stated that their stars came too late.)

More than three-fourths of those reporting considered that "starring has in general been beneficial" (135 slightly, 286 moderately, 142 notably). Only 6 considered starring harmful.

THE DESIRABILITY OF BROADENING THE BASIS FOR STARRING

According to nearly nine-tenths of those replying, starring would be beneficial "if in the future stars are awarded to the top 10% of the workers active in research in numerous fields (not only the present 12), by secret vote of the top third or so of the active workers in that field." (One hundred twenty-five voted "decidedly beneficial," 185 "moderately," 145 "slightly." Only 57 considered it would be inconsequential or undesirable.)

The increased specialization, which is almost unavoidable as knowledge accumulates, makes it increasingly desirable that those persons who are qualified to judge the merit of achievement in any particular field do so.

The secret balloting by competent experts should be extended to numerous additional fields. Aside from the encouragement that such recognition affords, another major advantage of such rating by secret ballot of those high in a wide variety of fields is that it increases the prospect that those who are judged outstanding will be given better opportunities to use their special talents and skills in the making of a better world. This happens partly because universities and other institutions dedicated to human betterment actively desire assistance in locating persons of especial merit so that they can obtain their services. Hence, the extension of starring to numerous fields not now represented would be highly advantageous and would certainly result in increased achievement.

Not only have nine-tenths of the 770 starred scientists who recently voted on the matter approved of a broadening of the basis for starring and expressed the conviction that the consequences would be advantageous, but large numbers of nonstarred scientists and persons who employ scientists have expressed similar opinions. It therefore appears that in the eighth edition of *American men of science*, now in preparation, many more persons should be starred than in the previous editions. Moreover, the voting should be done in fields small enough so that those selected to vote are better qualified to rate the younger workers than is possible when the fields are large and diversified (all of zoology, for example, or all of chemistry). This will mean extra work for those who arrange for and assemble the votes and for the publishers, but the benefits should abundantly justify the extra efforts.

NEWS *and Notes*

The Army's electronically-controlled C-54 recently used to demonstrate pilotless flight across the Atlantic was first developed early in 1946 and since then has been used on many shorter hops within the United States. From the time the flight commander, Col. J. M. Gillespie, set the automatic controls into action on the runway of the Newfoundland airport at Stephenville, it was not necessary for him or his crew to direct the flight in any way. Signals from two radio transmitters, located on ships at sea along the course of the flight, were interpreted by the plane's radio compass, and a third set of signals from a transmitter on a truck at the British airport brought it in for an automatic landing.

The 14 passengers making this initial flight included several U. S. scientists and an observer from the RAF.

About People

S. H. Katz, senior consultant, Chemical Corps Technical Command, Army Chemical Center, Maryland, is visiting England and Germany to investigate work on Chemical Warfare Protective Equipment. His investigation will cover materials, manufacturing processes, testing, and the theoretical aspects.

Allan D. Maxwell, formerly of the Nautical Almanac Office, U. S. Naval Observatory, has been appointed professor of astronomy, Howard University, Washington, D. C.

R. L. Meier, research chemist, California Research Corporation, has been appointed executive secretary, Federation of American Scientists, Washington, D. C., for one year to succeed **William Higinbotham.**

Arthur B. Bromwell, Northwestern University, was appointed secretary, American Society for Engineering Education, effective October 1. The headquarters of the Society will be moved from the University of Pittsburgh to Northwestern University.

Bowen C. Dees, assistant professor of physics, Rensselaer Polytechnic Institute, has been appointed physicist, Economic and Scientific Section of Gen. MacArthur's organization in Tokyo. In this position, Dr. Dees will survey and advise concerning the physical research being conducted in university and commercial laboratories in Japan.

Marjorie T. Bingham, formerly botanist, Cranbrook Institute of Science, has been appointed assistant professor of biology, Northern Michigan College of Education, Marquette.

C. Lee Huyck, professor and head, Division of Pharmacy, Columbia University College of Pharmacy, has resigned in order to become director, Department of Pharmacy, Howard College, Birmingham, Alabama.

Jacques Rousseau, director, Montreal Botanical Garden, has recently returned from a botanical survey in the interior of the Ungava Peninsula. Dr. Rousseau traveled by canoe from the source of George River to its mouth and crossed that peninsula from Seven Islands on the St. Lawrence River to the Ungava Bay.

Alexander Brunschwig, formerly professor of surgery, University of Chicago, has been appointed head, Department of Surgery, Memorial Hospital, Center for Cancer and Allied Diseases, New York City. Dr. Brunschwig also holds the concomitant appointment as professor of clinical surgery, Cornell University Medical College.

George A. Edwards, Harvard University, has been appointed assistant professor, Department of Biology, Tufts College, Medford, Massachusetts.

Frederick C. Frick, Columbia University, and **Moncrieff H. Smith**, Stanford University, have been appointed instructors in psychology at Harvard University.

Ethel Melsheimer Miller, librarian of the Botany and Zoology Library, Ohio State University, and of the Ohio Academy of Science, retired September 30. Mrs. Miller established the Botany and Zoology Library in 1917.

Marshall Clagett, instructor in history, Columbia University, has been appointed assistant professor, Department of the History of Science, University of Wisconsin.

Irving A. Denison, who has been connected with the Soil Corrosion Section, National Bureau of Standards, since 1929, has been appointed chief of the Bureau's Underground Corrosion Section.

Noel Elmer Foss, technical director, Department of Pharmacy, Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, has been appointed assistant dean, College of Pharmacy, University of Illinois.

Kenneth N. Ogle, formerly professor of research in physiological optics, Research Division, Dartmouth Eye Institute, Hanover, New Hampshire, has become a member of the permanent staff, Division of Physics and Biophysical Research, Mayo Foundation and Mayo Clinic, Rochester, Minnesota, where he will continue research in physiological optics and visual problems and carry on clinical researches in collaboration with the Section on Ophthalmology.

Robert J. Ollry, formerly a teacher at St. Lawrence University, has been appointed associate professor of biology and acting chairman, Department of Biology, Norwich University, Northfield, Vermont.

Max Hansen, formerly director of research, Durener Metallwerke, Duren, Germany, and a leading nonferrous physical metallurgist, has been appointed associate professor of metallurgical engineering, Illinois Institute of Technology.

J. A. Stekol, Amino Products Division, Rossford, Ohio, and **Denis R. A. Wharton,** Cornell University Medical College, have been appointed to the staffs of the Lankenau Hospital Research Institute, and the Institute for Cancer Research, Philadelphia.

William D. Gray, formerly chief, Biological Laboratories, U. S. Quartermaster Depot, Jeffersonville, Indiana, has been appointed associate professor, Department of Botany, Ohio State University.

Cecil A. Gibb, University of Sydney, Australia, has been appointed half-time visiting lecturer in the Department of Psychology, University of Illinois.

Hubert Bleier, who succeeded **Erich von Tschermak** at the School for Agriculture, Vienna, has informed **Lester W. Sharp,** Cornell University, that he was compelled to flee from Austria to Germany in 1945 and suffered the loss of all his possessions, including his scientific library. Prof. Bleier, who has now found employment in a seed improvement company, where he is carrying on researches on polyploid rye, would deeply appreciate the donation of any books, separates of articles in the fields of cytology, genetics, and agriculture, together with any other publications which would in some measure compensate for the loss of his library and that of the company with which he is associated. They may be sent in care of F. von Lochow-Petkus, 20a Bergen (Kreis Celle), Postschliessfach 5, Germany (British Zone).

Grants and Awards

Corrosion research being carried on in the Department of Chemistry, University of Texas, under the direction of **Norman Hackerman** is being supported by grants from the Office of Naval Research and the Natural Gasoline Association of America. Under the Navy grant **Don Marshall** and **Aubrey McClelland** will work on passivity of metals, especially chromium and stainless steel, and **John Sudbury** will carry out fundamental research on the mechanism of corrosion inhibitor action. The other grant provides for work being done by **E. E. Glen** on the mechanism of corrosion inhibitors, particularly in anaerobic systems.

The Kirksville College of Osteopathy and Surgery, Kirksville, Missouri, has received a $6,119 grant from the National Institute of Health to be used in support of the work of **J. S. Denslow,** director of research, who is studying the spatial relationship of muscle fibers in single motor units.

The Poultry and Egg National Board has announced that nominations are solicited for the Christie Award of $500 and a scroll, which will be presented at the annual meeting of the Board in Chicago in January of 1948. This award, made possible through a donation from Andrew Christie, will be presented each year for the next 5 years. The recipient will be the person who has made the greatest contribution in the past 10 years through research, teaching, or extension in the interpretation of scientific results or prosecution of research dealing with the determination, preparation, conservation, or improvement of the nutritive properties of poultry and eggs. Contributions must have served to enlighten the public regarding the value of poultry and eggs in the human diet or to increase the knowledge of the quality and nutritive value of poultry products. Further information may be obtained from the chairman of the Christie Award Committee, J. Holmes Martin, Purdue University, West Lafayette, Indiana.

Thomas H. Johnson, chief, Ballistic Measurements Laboratory, and associate director, Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland, during the war, and now head of the Physics Section, Brookhaven National Laboratories, received the Medal for Merit, the highest civilian award for war work from the Government, on September 25, in recognition of his outstanding wartime leadership in the development of highly accurate techniques for the measurement of the blast and fragmentation effects of bombs and in the development of microwave techniques for measuring velocities of projectiles, both in the bore of the gun and in flight.

Moses J. Eisenberg, chief, Dental Services, Jewish Memorial Hospital, Boston, and formerly research fellow in dentistry, Harvard University, was the recipient of the First Award for his exhibition at the recent Boston meeting of the American Dental Association. The award was given for original research in a basic science. Dr. Eisenberg's field is histology.

Fellowships

The General Electric Company has announced that applications are now being accepted for the academic year 1948–49 for grants under the $1,000,000 G-E Educational Fund which include the Charles A. Coffin Fellowships, awarded in the fields of electricity, physics, and physical chemistry, and the Gerard Swope Fellowships, first granted in 1946, awarded in the fields of industrial management, engineering, physical sciences, and any other scientific or industrial field. The fellowships will be granted for the amount needed up to a maximum of $1,500 annually for each individual. A grant of $500 may be made for specific apparatus or other expense in connection with the research work. In addition, in case of need, loans up to $1,000 may also be made. The fellowships are intended for graduates who need financial assistance and who have shown by the character of their work that they could with advantage undertake or continue research work in educational institutions either in this country or abroad. They are not intended for graduates who now hold, or expect to hold, any other fellowship which carries a stipend larger than the tuition at the institution where the research work is to be done. Applications, which must be filed by January 1, 1948, may be obtained from A. D. Marshall, secretary, General Electric Educational Fund, Schenectady, New York.

Colleges and Universities

The School of Medicine, Louisiana State University, has appointed **Harry E. Dascomb** instructor in medicine, **Robert M. Waters** instructor in surgery, **John J. Blasko,** clinical instructor in neuropsychiatry, **Louis Raider,** clinical instructor in radiology, **Simon V. Ward, Jr.,** clinical instructor in obstetrics and gynecology, **Harold S. Gamble** assistant in anatomy, **John D. Krafchuk** assistant in microbiology, **James T. McQuitty,** clinical assistant in surgery, and **Robert D. Bone,** clinical assistant in medicine. The school year has been expanded from 32 to 36 weeks.

A Department of Bacteriology was created July 1 on the Bloomington campus of Indiana University, having as its chairman **L. S. McClung,** associate professor. Instruction and research in bacteriology had been combined with botany since 1940. In the same Department, **S. E. Luria,** assistant professor, has been promoted to associate professor; **I. C. Gunsalus,** Cornell University, has been appointed professor and will have charge of a program relating to bacterial physiology and metabolism; **Herbert J. Welshimer,** Ohio State University, has been appointed instructor; **C. F. Robinow,** Strangeways Laboratory, Cambridge, has been appointed visiting professor during the spring semester and will give an advanced course in bacterial cytology; and **Charles Russell** and **Renato Dulbecco** will serve as research associates. Research in the Department will be supported in part by grants from the National Institute of Health and the American Cancer Society.

At the Marine Laboratory, University of Miami, Coral Gables, Florida, **Craig A. Gathman,** who has been appointed research associate in fisheries biology, is collaborating with **F. G. Walton Smith,** director of the Laboratory, in a study of the British Honduras fisheries carried out on behalf of that government. **Luis Rivas,** recently named associate professor of zoology at the University, is working on the taxonomy of West Indian marine fishes, a work which, it is hoped, will greatly add to the reference collection of Florida and West Indian marine fish at the Marine Laboratory; and **Charles C. Davis,** newly appointed assistant professor of zoology, is studying the plankton as part of a comprehensive ecological survey of the inshore waters near Miami.

The Geological Museum of the University of Minnesota has purchased from F. W. Sardeson his private collection of fossils which contains about 3,300 species, each being represented by from 1 to 100 specimens. Dr. Sardeson collected most of the specimens over a period of 50 years from the Ordovician rocks of Minnesota, Wisconsin, and Iowa. The collection also contains Jurassic invertebrates which Dr. Sardeson collected in central Europe while a student at Heidelberg.

Industrial Laboratories

Sharp & Dohme, Inc., has announced the following staff changes following a meeting of the Board of Directors: **John S. Zinsser,** president and chief executive officer, elected chairman of the Board; **William L. Dempsey,** executive vice-president, elected president to succeed Mr. Zinsser, who will continue as chief executive officer; and **William A. Feirer,** formerly vice-president in charge of medical research, elected executive vice-president and a director of the Company.

Maurice L. Moore, assistant director of research, Frederick Stearns & Company, has been appointed director of the Research Laboratories of Smith, Kline & French, Philadelphia, to succeed the late **Walter G. Karr.**

General Electric Corporation has recently developed, under the direction of **D. E. Bovey** in its General Engineering and Consulting Laboratory, a "metals comparator" which, by employing an electronic circuit, discriminates between the metal in question and a standard sample. Paint, polish, or rust on the metal does not affect its accuracy. It is expected that the device will prove useful in the inspection for quality of assembly line parts and in the rapid sorting of supplies of metal objects without damage to the metals.

Eastman Kodak Company has recently prepared a quantity of isotopic methyl iodide in its Synthetic Organic Research Laboratory. This chemical compound contains "tracer" C^{14} in an improved and highly usable form which does not require further extensive treatment before actual use, as did the previous heavy carbon produced by Kodak. The method used in making the new compound was one first used at the University of California in the preparation of compounds containing radioactive carbon. The National Research Council has received the first shipment of methyl iodide and will distribute it and later shipments to qualified research organizations.

Meetings

The American Mathematical Society will hold its 428th meeting at Hunter College, October 25, beginning at 10:00 A.M. Section I, on Analysis, in Room 1217, will hear papers by I. E. Segal, Institute for Advanced Study; Paul Erdös, Syracuse University; J. C. Oxtoby, Bryn Mawr College; Everett Pitcher, Lehigh University and Institute for Advanced Study; Arthur Sard, Queens College; and R. J. Duffin, Carnegie Institute of Technology. At the meeting of Section II, on Algebra, Topology, and Logic, in Room 1239, papers will be presented by O. E. Glenn, Lansdowne, Pennsylvania; G. C. Webber, University of Delaware; Saunders MacLane, University of Chicago; L. V. Toralballa, Fordham University; E. H. Spanier, Institute for Advanced Study; Hing Tong, National Research fellow, Institute for Advanced Study; and Ira Rosenbaum, Brooklyn College. A general session, to be held at 2:00 P.M. in the High School Auditorium, will feature a lecture on "Global Theorems in Riemannian Geometry" by C. B. Allendoerfer, Haverford College.

The National Academy of Sciences will hold its autumn meeting November 17–19 at 2101 Constitution Avenue, Washington, D. C. The sessions on Monday will be devoted to a discussion of the functions of the Academy with reference especially to its relations to the Government and other groups and to the character of its scientific sessions. Scientific papers will be presented at the morning and afternoon sessions on Tuesday, and the morning session on Wednesday. The Public Lecture will be given Monday evening at 8:30 in the Academy Auditorium, and the Academy Dinner will be held Tuesday evening at the Hotel Washington at 6:30. F. E. Wright, Geophysical Laboratory, Carnegie Institution of Washington, is chairman of the Local Committee on Arrangements.

The American Philosophical Society will hold its autumn general meeting November 20–21 in Philadelphia. At the open sessions on these two days, beginning at 10 A.M. Thursday, papers will be read by: Lyman H. Butterfield, Leonard Carmichael, Wallace O. Fenn, Paul D. Foote, Werner Jaeger, Chester S. Keefer, Hayward Keniston, William L. Langer, O. E. Neugebauer, William G. Roelker, Carl O. Sauer, Robert L. Schuyler, Harlow Shapley, Sumner H. Slichter, Mark Starr, Francis R. Steele, Vincent du Vigneaud, and William L. Westermann. On the evening of November 20 Douglas S. Freeman will give the Franklin Medal Lecture on the subject of recent discoveries concerning George Washington.

The annual meeting of the Society of Rheology will be held October 30–November 1 at the Hotel Pennsylvania, New York City. The program follows: Friday morning, "Measurements of Stress Relaxation in High Polymer Materials," W. S. Macdonald and Alexis Ushakoff, W. S. Macdonald Company, Cambridge, Massachusetts; "Rheological Properties of Polystyrene," Rolf Buchdahl, Monsanto Chemical Company, Springfield, Massachusetts; and "Viscous Flow of Molten Polystyrene," R. S. Spencer and R. E. Dillon, The Dow Chemical Company, Midland, Michigan; Friday afternoon, "The Cragoe L Function for Viscosity of Oils Under Pressure at Certain Temperatures," R. B. Dow, Bureau of Ordnance, Navy Department, Washington, D. C.; "The Viscosity Basis of Plasticizer Action," H. Jones and E. Chadwick, Plastics Division, The Geigy Company, Ltd., Manchester, England; "Viscosity and Shear Elasticity Measurements of Liquids by Means of Shear Vibrating Crystals," W. P. Mason, Bell Telephone Laboratories, Murray Hill, New Jersey; and the annual business meeting at 3:45 P.M. A social program in the evening will include color movies by K. Compton, Bell Telephone Laboratories. Saturday morning, "Theory of Plastic Flow Versus Theory of Plastic Deformation," W. Prager, Brown University; "Anomalous Viscosity of Aluminum Soap-Benzene Gels," Walter H. Bauer, Henry Raich, and Grant K. Rauscher, Rensselaer Polytechnic Institute; "New Aspects of Colloid Science to Rheology," Ernst A. Hauser, Massachusetts Institute of Technology; and "Pseudoplastic Flow Properties of Lyophilic Colloids," Earl K. Fischer and Charles H. Lindsley, Institute of Textile Technology, Charlottesville, Virginia.

The IXth General Assembly of the International Union of Biological Sciences was held in Copenhagen July 28, 1947, with participation of representatives of UNESCO and of the International Council of Scientific Unions (ICSU), and delegates of the following countries: Belgium, Brazil, Bulgaria, Czechoslovakia, Denmark, France, Great Britain, Holland, Mexico, Morocco, Norway, Poland, Spain, Sweden, Switzerland, United States. The representative of China, delayed, sent his regrets from Marseille in not being able to arrive in time. Prof. Borel, vice-president of ICSU, was present at the Assembly, which was of particular importance. Actually the General Assembly had not been able to be convened since 1935 as a consequence of world events. Revised statutes were therefore adopted by the Assembly, and new activities were undertaken appropriate to new circumstances.

The new Bureau was thus constituted: president: M. J. Sirks, Genetisch Instituut, Huis de Wolf, Haren (Gron.), Holland; vice-president: H. Munro Fox, Department of Zoology, Bedford College for Women, Regents Park, London N.W.1, England; secretary general: P. Vayssiere, Museum d'Histoire Naturelle, 57 Rue Cuvier, Paris Ve, France; associate secretary general: **Stuart Mudd**, School of Medicine, University of Pennsylvania, Philadelphia 4; treasurer: F. Chodat, Institut for General Botany, University of Geneva, Switzerland.

Joseph Needham, representing UNESCO, in agreement with A. Establier, representing ICSU, indicated that the great international organization of UNESCO attached a very special importance to the activities and investigations pursued by the Unions, and that UNESCO would aid in their realization, it being understood, however, that the maintenance of the Unions themselves must be assured by their own resources. In brief, these international Unions are self-sustaining organizations supported by contributions from adhering nations. Substantial sums from UNESCO will be distributed, however, through these Unions as grants-in-aid or subventions to particular projects.

The creation of new Sections was planned—Experimental Cytology, Embryology, Entomology, Genetics, Microbiology, Zoology—and also several mixed Commissions, such as Radiobiology, Natural Calamities, Oceanography. These last Commissions should comprise members of other Unions. The Executive Committee, which convened on October 2, was to assure the carrying out of these projects.

After having reviewed the actions of the International Congresses of Experimental Cytology at Stockholm and of Microbiology at Copenhagen and those to take place later in 1947 under the auspices of IUBS (Symposia on Trace Elements in Plants and on Biological Antagonisms), the following program of activities was established for 1948 and 1949: *International Congresses*—Genetics (Stockholm), Entomology (Stockholm), Zoology (Paris), Silkworm Culture (Ales (Gard)), Physiology and Pathology of the Reproduction of Animals (Milan); *Symposia*—Bases of Nomenclature and of Systematic Botany (Utrecht), Terminology of Genetics and Cytology (Stockholm), Interaction of Egg and Sperm (Milan), Embryological Chemistry (Berne), Development and Regeneration of Nerves (probably in the United States).

There were also proposed: (1) Symposia on the Role of Anaerobes in Nature, on Nomenclature in Zoology and Entomology, and on Evolution in Biology; (2) Publication of a Catalogue of Type Specimens of Animal Species and of Historical Collections; (3) Distribution of Artificial Radioactive Isotopes for Experimental Biology; (4) Creation of a Center of Marine Biology in the Malay Archipelago; and (5) Formation of an Association of Directors of European Botanical Gardens.

Finally the Assembly approved unanimously the resolution transmitted to it by the Congress of Microbiology with regard to prohibiting all means of biological warfare. This resolution had been adopted by acclamation at the final Plenary Session of the Fourth International Congress of Microbiology held in Copenhagen July 26:

"The Fourth International Congress of Microbiology joins the International Society of Cell Biology in condemning in the strongest possible terms all forms of biological warfare. The Congress considers such barbaric methods as absolutely unworthy of any civilized community and trusts that all microbiologists throughout the world will do everything in their power to prevent their exploitation."

The next Assembly will take place in 1950, probably at Stockholm. The International Union of Biological Sciences invites all countries not at present adhering to join the Union in the interests of science in general and of each country in particular.

For all information address the Secretary General, Prof. P. Vayssiere, 57 Rue Cuvier, Paris Ve, France.

The American Type Culture Collection, located at Georgetown University School of Medicine for the past 10 years, is to be established soon in a laboratory of its own at 2029 M Street; N. W., Washington 6, D. C. The staff will consist of **Ruth E. Gordon,** curator, **Isabel Christison,** mycologist; **Ruth Davis,** bacteriologist; and **Katherine Alvord,** secretary and business manager. **Ralph St. John-Brooks,** retired curator, National Collection of Type Cultures, Lister Institute, London, and present permanent secretary, International Association of Microbiologists, and collaborator, Centre de Collection de Type Microbiens, is returning from Switzerland in November and will occupy an office in the new laboratory. The task of examining the 4,000 cultures of the Collection for viability and purity, begun in 1944, is nearly finished. A complete catalogue of the American Type Culture Collection strains will be published as soon as possible after the appearance of the 6th edition of Bergey's Manual.

The figuring of the 200-inch telescope mirror was completed October 3, its parabolic surface reaching perfection within two millionths of an inch, according to the results of John A. Anderson, who has been in charge of the optical work, Ira S. Bowen, director, Mount Wilson Observatory, and members of the Observatory Council, who devised new methods of testing the mirror surface to check the accuracy of previous testing methods. The giant disc, weighing about 20 tons before the grinding, and larger than the floor of a two-car garage, was cast in 1935 by the Corning Glass Works and shipped to the California Institute of Technology the following spring. Five and one-quarter tons of glass were removed in the grinding and polishing of the mirror, under the direction of Marcus H. Brown. The disc will now be aluminized and mounted in the observatory built for it on the top of Mount Palomar in California, 130 miles southeast of Pasadena. It is expected that the telescope will be in operation by early summer of 1948. Both the Mount Palomar and the Mount Wilson Observatories will be operated jointly by the California Institute of Technology and the Carnegie Institution of Washington.

The first foreign shipment of radioisotopes produced from the atomic pile at Clinton Laboratories, Oak Ridge, Tennessee, left September 5 for the Commonwealth X-Ray and Radium Laboratory, Melbourne, Australia. The shipment, which consisted of 20 millicuries of phosphorus 32 for treatment of an urgent case of polycythemia vera, was made by air since phosphorus 32 has a half-life of only 14.3 days.

At the High Plains Potato Conference held in Monte Vista, Colorado, on August 15, a new organization, the Intermountain Plant Pathologists, was formed by 12 plant pathologists from that region. Through the society plant pathologists of the Intermountain Region will be able to maintain closer contact with each other with respect to plant disease problems in the region and thus more effectively attempt to solve such problems. Membership in the society, an unofficial branch of the American Phytopathological Society, is open to plant pathologists in Idaho, Montana, Nebraska, Wyoming, Utah, Colorado, New Mexico, and Arizona. W. D. Thomas, Jr., of Colorado A & M College, is chairman of the group for the coming year; W. J. Henderson is secretary.

A new observatory for the daily determination of the radiation of the sun at sea level is now being set up at Miami, Florida, as a part of the program of the Smithsonian Institution's Astrophysical Observatory, directed by **L. B. Aldrich.** Other similar observatories under Smithsonian direction are located on the tops of Mt. Montezuma in Chile, and Table Mountain in California, where the amount of heat radiation from the sun is least affected by dust or water vapor in the atmosphere. The Miami station, however, where the atmosphere is considerably more dense, will be an especially desirable place for studying the effects of the absorption by water vapor. The new station will also cooperate with the Army in measuring the effects of solar radiation on various fabrics. Mr. Aldrich is now looking for another high mountain site in Mexico for an observatory to replace one recently abandoned at Tyrone, New Mexico.

Clinton Laboratories, at Oak Ridge, Tennessee, which have been operated since July 1945 by the Monsanto Chemical Company, are to be renamed Clinton National Laboratory and, under the terms of a four-year contract now being negotiated, will henceforth be operated by the University of Chicago. The Laboratory will thus become the third of AEC's national laboratories. The first to be established, Argonne National Laboratory, also operated by the University of Chicago, has as participants 29 institutions throughout the Midwest, while Brookhaven National Laboratory, operated by Associated Universities, Inc., is composed of 9 eastern universities. At Clinton 14 southern universities in the Oak Ridge Institute for Nuclear Studies and a score of industries and industrial representatives will participate in the research, development, and training programs. This plan of establishing national laboratories, conceived by Manhattan District's Advisory Committee on Research Policy, has as a major objective the utilization of research personnel and facilities of industry and academic institutions throughout the country and institution of a program of training in the nuclear sciences. The Oak Ridge Institute for Nuclear Studies, headed by Frank P. Graham, president, University of North Carolina, and formed last year to promote activities in nuclear science in southern universities, includes as members Alabama Polytechnic Institute, Catholic University of America, Duke University, Emory University, Georgia School of Technology, Louisiana State

University, Tulane University, the Universities of Alabama, Kentucky, North Carolina, Tennessee, Texas, and Virginia, and Vanderbilt University.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, lists the following wanted chemicals: 6-hydroxy-2,2,5,7,8-pentamethylchroman; d-2-desoxyribose; hydrocoerulignone; diborane; deuteroammonia; coniferin; nitroarginine; agmatin; galegin; canaline; canavanene; hydroxylysine; laudanosine; 3-chloropyridazine; pyridazone; pyridazone-3-carboxylic acid; pyridazinone-3-carboxylic acid; xanthopterin; desoxypyridoxine; ethionine; carbon oxyselenide; and carbon sulfoselenide.

The Huancayo Magnetic Observatory, the most important of its kind in this hemisphere, has now been transferred to the Government of Peru from the Carnegie Institution of Washington, in accordance with the latter's policy of transferring fixed observatories to the governments of countries in which they are located, and also in accordance with the recommendation of the International Union of Geodesy and Geophysics that governments take over such facilities within their own territory because of their importance to national economy. The Observatory, functioning autonomously, will be supervised by a Directive Committee headed by Jorge Broggi, director, Geological Institute of Peru, and including three Peruvian scientists, and three U. S. representatives: J. M. Hydrick, Rockefeller Foundation, and now of the Peruvian Ministry of Public Health; John A. Fleming, formerly director, Department of Terrestrial Magnetism, Carnegie Institution, and currently special adviser to the Institution in international scientific affairs, who led in the establishment of the Observatory in 1922; and the cultural attaché of the U. S. Embassy in Peru.

The Swedish Deep Sea Expedition

The Swedish Deep Sea Expedition, organized by, and under the personal direction of, Hans Pettersson, director of the Oceanografiska Institutet, left Göteborg on July 4, 1947, on the 1,450-ton motor schooner *Albatross*. The trip is expected to last approximately 15 months, and during that time oceanographic studies will be conducted in low-latitude regions in the Atlantic, the Caribbean, the Pacific, the Indian Ocean, and the Mediterranean. On August 20, 1947, the *Albatross* had reached the Canal Zone and was scheduled to proceed to Tahiti via the Galapagos and Marquesas Islands, thence to Hawaii and the Netherlands East Indies, and through the Indian Ocean to the Mediterranean.

The principal work of the expedition is to obtain cores of sediment in the deep ocean basins. These are taken with the new piston core sampler developed by Börje Kullenberg, and undisturbed cores have been obtained up to 20 meters in length. The events recorded in these deep-sea cores should greatly add to our meager knowledge of the recent history of the oceans, and such long cores may extend a few millions of years into the geologic past when obtained from the center of a large ocean basin. In addition to cores, continuous depth records are made with a new type of British fathometer which records on a larger scale than any other at present in use. Depth profiles from the Atlantic basins show a remarkable roughness of the bottom in the deep basins in many places with several abrupt changes in depth suggesting fault zones. Waloddi Weibull is measuring the apparent thickness of the deep ocean sediments by means of sonic reflections recorded from the explosion of small depth bombs. In the Caribbean Weibull has obtained a probable thickness ranging from 1,000 to 3,000 feet. Complete hydrographic stations are being occupied at regular intervals, and the intensity of light penetration is being measured at various depths. Large water samples also are being collected from deep water layers for a study of their radioactivity.

It was the good fortune of the undersigned to be the guest of the expedition on its way from Martinique to the Canal Zone, representing the Hydrographic Office of the Navy Department and the Woods Hole Oceanographic Institution. Towing techniques for living Foraminifera were demonstrated, and a new type of bottom sampler was loaned to the party. The *Albatross* is admirably fitted out for a round-the-world cruise, and the scientific party and ship officers and crew are of the highest degree of competence. The ship is a freighter and merchant officer training ship with the midship section converted into laboratories and quarters for the scientific staff. On the main deck is a large general laboratory as well as a chemical and biological laboratory. On the second deck is a large laboratory for treating the cores, which are opened on board, a large refrigeration room for the preservation of certain materials, an aquarium room, a completely equipped photographic dark room, and a small machine shop. The large winch for operating the piston core sampler is in the forward hold and is equipped with 7,500 meters of unspliced heavy cable.

It is interesting to note that the cost of the expedition (approximately $500,000) is not being borne by the government of Sweden, but is made up entirely of donations from private Swedish citizens who are interested in sponsoring the pure science of oceanography. This is a remarkable achievement for a country having only about 4 per cent of the population and 1 per cent of the wealth of the United States and now being subjected to severe income taxation. There is no doubt that the Swedish Deep Sea Expedition will produce results which are of fundamental importance to oceanography. (FRED B. PHLEGER, JR., *Woods Hole Oceanographic Institution.*)

Erratum. The price of *Thermodynamics for chemists* by Samuel Glasstone was incorrectly quoted in its review by Don M. Yost in *Science*, September 26. The book is a single volume, not one of a series, and its correct price is $5.00.

Make Plans for—

American Institute of Electrical Engineers, Midwest General Meeting, November 3–7, Chicago, Illinois.

American Institute of Chemical Engineers, November 9–11, Detroit, Michigan.

National Committee for Mental Hygiene, November 12–13, Hotel Pennsylvania, New York.

American Society of Animal Production, November 28–29, Chicago, Illinois.

The Society of American Foresters, Annual Meeting, December 18–20, Minneapolis, Minnesota.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS
by Readers

The undersigned welcome this opportunity to discuss the questions raised by Dr. Potter (*Science*, October 10, p. 342), which will be taken up under the separate numbers which he has listed:

(1) Whether or not there is a relative unsaturation of cytochrome C within the cell is unknown, since the answer to this question is not accessible to direct experimental proof. We suggested a possible excess of cytochrome oxidase over cytochrome C in the tissues on the basis of the following data:

From the saturation curve of Stotz, Altschul, and Hogness (*J. biol. Chem.*, 1938, **124**, 744) it was calculated how much cytochrome would be required to saturate the amount of oxidase indicated by the oxygen consumption of various tissues under the conditions of the assay method for cytochrome oxidase. These values were compared with the amounts of cytochrome actually found in various tissues by Potter and DuBois (*J. biol. Chem.*, 1942, **142**, 417). Stotz, Altschul, and Hogness stated that in their saturation curve the velocity of cytochrome oxidation and not that of its reduction is the limiting factor. According to the authors, the oxygen uptake at the end of the measurement accounted at each point of the curve for maximally 25 per cent of the cytochrome C. Thus, even assuming a slow re-reduction, at least 75 per cent of cytochrome C was still present in the reduced form at the time of the reading. The assay method for cytochrome oxidase is likewise carried out under conditions under which the rate of cytochrome oxidation is the limiting factor.

It is very likely that the application of such simplified calculations to the conditions of the living tissues ignores important factors such as that of the structure or of the influence of other metabolites. On the other hand, it appears to be of interest to compare the available quantitative data concerning the isolated cytochrome oxidase-cytochrome C complex with the assay figures obtained on various tissues. Actually, our physiologic and clinical experiments with cytochrome C are independent of these theoretical calculations. This should not, however, preclude attempts to interpret the available data in a preliminary manner.

(2) We have been intrigued by the question of whether or not the injected cytochrome C penetrates to the inside of the cells, but we have made no statement to the effect that it does. While we have demonstrated that the cytochrome C contents of some organs are increased following parenteral injection, there is as yet no evidence that cytochrome C, being a protein and hence a fairly large molecule, can penetrate cell membranes and thus take part in intracellular activities. The increase in organ content of cytochrome C is considerably more than can possibly be accounted for by the increased content in the circulating blood which resulted from the injection. If the material does not reach the interior of the cells, it might conceivably accumulate in the tissue spaces or perhaps on the surface of the cells. The fact that it does influence physiologic behavior, however, suggests that the cytochrome C probably does enter the cells. If it were assumed a priori that the cytochrome C molecule is too large to be physiologically active after parenteral injection, then one might with equal logic assume that insulin, which is a much larger molecule, or a host of other substances of large molecular weight, could not be effective. Such effectiveness probably indicates cellular penetration.

(3) In our experiments an attempt was made to control the "dilution factor" by adding sufficient cytochrome C to the control vessel to render the concentration of cytochrome C in the total homogenate equal to that in the undiluted tissue.

(4) We have reported (a) that under the conditions of our experiments (2) anoxia reduces the amounts of the easily hydrolyzable phosphorus of rat organs (hearts and kidneys), and (b) that the previous injection of cytochrome C seems largely to prevent this decrease. While Scheinberg and Michel (*Science*, April 4, pp. 365–366) also found that anoxia would reduce the amounts of easily hydrolyzable phosphorus in rat organs, they were unable to confirm our observations on the cytochrome C effect in overcoming some of this reduction. This led us to repeat our own experiments on rat hearts. Our subsequent results were essentially as originally reported by us. That Scheinberg and Michel did not obtain similar results, although presumably using essentially the same procedure and methods, suggests the desirability of clarification of this question by other workers for, as Dr. Potter states, "this experiment would be decisive if it could be confirmed."

Dr. Potter has suggested that there is some question as to whether our technique of fixing the tissues was sufficiently quick to preserve the phosphorus compounds and implied that we should have used the method of freezing by liquid air. The method which we employed was the immediate homogenization of the quickly excised organ in ice-cold trichloracetic acid. The advantages of freezing in liquid air are at least equivocal for two reasons. First, freezing by air is not instantaneous through any considerable depth of tissue; there is a significant gradient. Second, the immersion of a muscle into liquid air acts to stimulate the muscle to maximal contraction and thus fixes it not in the metabolic stage prior to immersion, but in an extraneously produced physiologic condition. It is very likely that a similar stimulatory effect occurs in other organs.

(5) We feel, as Dr. Potter does, that the question as to whether or not cytochrome C is of any therapeutic value will have to be answered on the basis of the results of investigators in a number of clinics. It is notoriously difficult to evaluate therapeutic effects in many clinical conditions, a good example being angina pectoris, which is one of the conditions we have been studying. The only clinical condition in which we have had any considerable experience with cytochrome C therapy is intermittent claudication. In 26 of 39 such patients there seem to have been significant measurable benefits. It may well be that the mechanism of this benefit is entirely different from that which we have presupposed. Even so, our working hypothesis has not been without value.

We, too, are interested in seeing a sufficient body of facts accumulated by qualified and impartial observers so that the true status of the results of our tentative explorations can be determined. The pharmaceutical houses can be helpful by supplying the material necessary to obtain these facts. (SAMUEL PROGER, G. SCHMIDT, and D. DECANEAS, *Joseph H. Pratt Diagnostic Hospital, Tufts College Medical School, Boston.*)

TECHNICAL PAPERS

Effect of Rutin on Anaphylactic and Histamine Shock[1]

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In the anaphylactic shock in man and in animals histamine plays an important role, but its liberation does not explain all phenomena observed (*1*). The discovery of rutin as an important tool to affect capillary permeability has given us the means to analyze the role played by capillary permeability in the shock produced in the guinea pig by anaphylaxis and by the administration of histamine.

Medium-sized guinea pigs were sensitized by an intraperitoneal injection of 0.25 cc. of normal horse serum. After a 12-day interval the animals were shocked by a parenteral dose of horse serum.

Series I consisted of 8 animals. These were sensitized and then divided into two groups. Three animals received 2 mg. of rutin intraperitoneally 30–45 minutes before anaphylactic shock was produced. The crystalline rutin was dissolved in 2 per cent NaOH to which 2 per cent acetic acid was added carefully to a point just short of precipitation. The solution was then diluted with distilled water to a volume convenient for injection. The above procedures had to be performed while maintaining the solutions at a temperature below 15° C. to prevent degradation of the rutin. Reaction at higher temperatures was indicated by color changes in the solution.

All animals were then given intracardially a shocking dose of 0.05 cc. of normal horse serum /100 grams body weight. The 3 animals which had received a prior injection of rutin manifested no symptoms. The 5 retained as controls died within 6 minutes, exhibiting the characteristic syndrome of anaphylactic shock in the guinea pig.

Series II consisted of 11 animals sensitized in the previously described manner. These were divided into two groups, one of which, consisting of 5 animals, received 1 mg. of rutin intraperitoneally 30–45 minutes before shocking. The control group received intraperitoneal injections of the same quantity of NaOH and acetic acid solution as used in dissolving the rutin for the first group.

Shocking doses of 0.5 cc. of normal horse serum were administered intracardially to all animals. The 5 which had received rutin showed no signs of shock, while the 6 controls died in 4–10 minutes with typical symptoms of anaphylactic shock.

Series III (11 animals) was subjected to procedures identical with those of Series II except that the solvent for rutin used here was propylene glycol, 0.5 cc. /dose. The controls received injections of the same amount of propylene glycol only.

In this series the 5 controls again died in anaphylactic shock within 10 minutes. Five of the 6 rutinized animals were without signs of anaphylactic shock, while the sixth, which received its shocking dose 60 minutes after the administration of rutin, died in anaphylactic shock in about 15 minutes. Whether this increased time interval between the administration of rutin and its apparent failure to protect is significant has not as yet been determined.

After finding that rutin protected against anaphylactic shock, presumably through its action on capillary permeability, we proceeded to examine the effects of rutin on the shock produced by histamine.

Of a batch of 21 guinea pigs, 6 animals were used to determine the minimal lethal dose of histamine dihydrochloride (donated by Hofmann-LaRoche) injected intracardially or intravenously. Nine animals were given 1 mg. of rutin in 0.1 cc. of propylene glycol intraperitoneally 30–45 minutes before receiving the minimal lethal dose of histamine. The 9 controls received only the propylene glycol.

All animals in both series died within 10 minutes after administration of the histamine, exhibiting the characteristic symptoms of histamine shock.

Our results demonstrate that rutin protects guinea pigs against the fatal effects of anaphylactic shock but not against those of histamine shock. If we assume that rutin protects against anaphylactic shock by virtue of its tightening effect on the capillary endothelium, then histamine may be excluded as the lethal factor of anaphylactic shock. However, in the guinea pig in anaphylactic shock, the dominating picture is that of bronchiolar constriction. In guinea pigs injected 30–45 minutes before the induction of anaphylactic shock with rutin, no spasm of the bronchioles was apparent, and their lungs were found to be normal. On the other hand, injected histamine produced the syndrome of protein anaphylactic shock with bronchiolar spasm and changes in the lungs. A clinical difference between shock induced by either anaphylaxis or by injection of histamine was hardly recognizable.

Another explanation for the protective effect of rutin may be that it prevents the liberation of endogenous histamine, perhaps by unknown factors other than those which increase capillary permeability. The latter explanation seems to be more reasonable because its protective effects on anaphylactic shock are of rather short duration, while its effectiveness on capillary permeability in purpuric disease seems to be more protracted. The latter thought may be sustained also by the findings of Hiramatsu (*2*), who found that guinea pigs were protected against anaphylactic shock by large doses of hesperidin. While the latter preparation may have contained some vitamin P, it may have prevented the liberation of endogenous histamine in a manner similar to that of rutin. Hiramatsu did not report whether hesperidin protected against histamine shock.

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Ammonia Nitrogen Produced From Isomeric Peptides in Kidney Homogenate Digests

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On aerobic incubation of glycyl-*dl*-alanine and of *dl*-alanylglycine with aqueous homogenates of rat kidney tissue, we noted that considerable ammonia accumulated in digests of the former peptide while little or none appeared in those of the latter. Essentially similar findings were observed with isomeric peptides of *dl*-leucine (Table 1). Of further interest was the fact that the ammonia which appeared in digests of glycyl-*dl*-alanine and of glycyl-*dl*-leucine was close in order of magnitude to that which appeared in digests of *dl*-alanine and *dl*-leucine, respectively. Of the isomeric tripeptides studied, only glycylglycyl-*dl*-leucine yielded ammonia.

TABLE 1

AMMONIA N PRODUCED FROM PEPTIDES AND AMINO ACIDS IN AEROBIC DIGESTS OF RAT KIDNEY HOMOGENATES[*]

Substrate	Hours of incubation	Ammonia N in micromoles[†]
dl-Alanine	4	6
"	8	10
Glycyl-*dl*-alanine	4	6
"	8	10
dl-Alanylglycine[‡]	4	<1
"	8	1
dl-Leucine	4	5
"	8	9
Glycyl-*dl*-leucine	4	5
"	8	9
dl-Leucylglycine	4	<1
"	8	1
l-Leucine	4	1
Glycyl-*l*-leucine	4	1
Glycine	8	0
Glycylglycine	8	0
dl-Valine	4	5
dl-Isovaline	4	0
dl-Leucylglycylglycine	4	0
Glycyl-*dl*-leucylglycine	4	0
Glycylglycyl-*dl*-leucine	4	5
d-Leucylglycine[§]	4	0
d-Leucylglycine + 0.001 M $MnCl_2$	4	1
d-Leucylglycine + Mn + *l*-leucine	4	<1
d-Leucylglycylglycine	4	0
d-Leucylglycylglycine + 0.001 M $MnCl_2$	4	0

[*] Digests consisted of 1 cc. of dialyzed homogenate equivalent to 333 mg. of tissue, plus 2 cc. of 0.15 M borate buffer at pH 8.1, plus 1 cc. of 0.05 M racemic or 0.025 M optically active substrate. Enzymatic activity was measured by the amount of ammonia produced, corrected for the extract blanks. No ammonia was produced from any substrate when the digestion was conducted under anaerobic conditions. Temperature, 37° C.

[†] Theoretical maximum, 25 micromoles from each optically active component.

[‡] Chloroacetyl-*dl*-alanine and chloroacetylglycyl-*dl*-leucine in similar aerobic digests yielded no ammonia N.

[§] $[\alpha]_D = -82°$.

The ammonia which appears from the racemic substrates under these experimental conditions is due principally to *d*-amino acid oxidase activity and may be related specifically to the oxidative desamination of the *d*-amino acid moiety of the peptides (*5*). Neither *l*-leucine nor glycyl-*l*-leucine yields appreciable ammonia under these conditions. That the oxidative desamination involves the α-β hydrogen atoms of the substrate is revealed in the relative susceptibility of *dl*-valine and of *dl*-isovaline (Table 1). The latter possesses a tertiary carbon atom. Manometric procedures of estimating peptidase activity through amino acid oxidase have been reported (*4, 7*).

The contribution of the *l*-amino acid components to the yield of ammonia in digests of the racemic, isomeric peptides may therefore be relatively neglected, and the role of the natural *l*-peptidase in the splitting of the *l*-form of the peptides in the kidney digests is not of immediate concern in the interpretation of the phenomena. This leaves for consideration only the *d*-form of the peptides, namely, *d*-alanylglycine and *d*-leucylglycine on the one hand, and glycyl-*d*-alanine and glycyl-*d*-leucine on the other. Two alternative explanations for the behavior of the isomeric peptides may be offered.

(1) *d*-Amino acid oxidase may be considered as acting only on free *d*-amino acids, and therefore the ammonia noted in digests of the racemic peptides could only have arisen subsequent to the action of *d*-peptidase on the peptides liberating the free amino acids. On this basis, it would appear that glycyl-*d*-alanine and glycyl-*d*-leucine were very susceptible, whereas *d*-alanylglycine and *d*-leucylglycine were relatively resistant, to the action of *d*-peptidase. This would not be in agreement with the relative susceptibility of the corresponding *l*-peptides to intestinal dipeptidase, whereby alanylglycine is hydrolyzed at twice the rate as glycylalanine (*6*). A slight, but definite, manganese-activatable *d*-leucylpeptidase activity is noted in the rat kidney digests (Table 1) (cf. *7*). This activity is slightly depressed by the addition of *l*-leucine.

(2) *d*-Amino acid oxidase may be considered as acting not only on the free *d*-amino acids, but also upon *d*-amino acids bound through the amino group in peptide linkage with another amino acid. Such a concept is in harmony with Bergmann's view that the oxidative desamination of amino acids might be effected while they are in the peptide chain, yielding by an α-β dehydrogenation the corresponding dehydropeptide, which subsequently is split by dehydropeptidases to products which include ammonia and keto acids (*1*). Thus:

$$(1)\quad RCH(NH_2)CONHCH(CH_2R^1)COOH \xrightarrow[\text{Oxidase}]{-2H}$$

$$RCH(NH_2)CONHC({=}CHR^1)COOH \xrightarrow[\text{Dehydropeptidase}]{H_2O}$$

$$RCH(NH_2)COOH + NH_3 + CH_2R^1C({=}O)COOH$$

$$(2)\qquad 2H + O \rightarrow H_2O.$$

On this basis, dipeptides which contain a glycine residue at the carboxyl end of the chain, as in alanylglycine and leucylglycine, could not form dehydropeptides, whereas peptides like glycylalanine and glycylleucine could form such α-β unsaturated peptides. Kidney tissue is, of all animal tissues, richest in both *d*-amino acid oxidase (*5*) and dehydropeptidase (*2*).

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[1] Rockefeller Foundation Fellow, on leave from the University of Brasil, Rio de Janeiro.

The second of these alternatives was sympathetically considered by Krebs in his early work on the subject of amino acid oxidation, but no decision was reached by him (*5*). On the basis of our present data, we are inclined to favor this second alternative, which is not only consistent with the Bergmann concept of intracellular peptide metabolism, but also supplements earlier work from this laboratory on the enzymatic susceptibility of peptides of *l*-cystine (*3*). In the final analysis, however, the Bergmann concept can only be proved by separation of the enzymes involved, and work on this possibility is in progress.

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Use of Insoluble Penicillin Salts for the Prolongation of Penicillin Blood Levels

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Many methods have been proposed for prolonging blood levels of penicillin. The one usually employed in medical practice is that proposed by Romansky and Rittman (*3*), namely, an intramuscular injection of a suspension of calcium penicillate in beeswax and a vegetable oil. This method has the disadvantage of using a substance (beeswax) of variable composition which may not in all cases be completely absorbable.

In a search for a method of prolonging penicillin blood levels, the writer decided to investigate the insoluble penicillin salts. These compounds have not been used until now because it was believed that the penicillin in such salts was irreversibly inactive. Thus, Abraham and Chain (*1*) found that penicillin was inactivated by a large number of metallic ions—copper, lead, zinc, cadmium, nickel, mercury, and uranium. They also reported that no activity could be recovered by decomposing the inactivated material with acid and extracting with ether. Bacharach and Hems (*2*) state that zinc, copper, mercury, and lead inactivate penicillin rapidly and iron less rapidly. Whether this inactivation is due to the formation of an insoluble penicillin or whether there is a definite chemical change in the penicillin is a subject for future investigation.

It occurred to the writer that there was a possibility that the inactivated insoluble penicillin might be reactivated *in vivo*. If this proved to be true, the insoluble salt would be more slowly absorbed than the soluble sodium, potassium, and calcium salts now in use and would therefore result in a marked prolongation of blood levels. Moreover, all the substances used would be completely absorbable. These suppositions were correct, as shown by the following data.

A control intramuscular injection in a rabbit of 20,000 units/kg. of penicillin suspended in peanut oil gave no readable blood level after 5 hours. On the other hand, a similar injection of silver penicillate produced a blood level of .08 units/cc. at 17 hours and .03 units at 20 hours; one of mercury penicillate, a level of .08 units at 17 hours and one of ferric penicillate, a level of .16 at 17 hours and .02 at 20 hours.

Penicillin produces insoluble salts with iron, copper, tin, vanadium, lead, lanthanum, cesium, zirconium, mercury, bismuth, silver, gold, and probably many other metals. Insoluble salts are also obtained with numerous organic substances, basic or cationic in character, such as the triphenylmethane dyes, namely, gentian violet, brilliant green, crystal violet, methyl violet, and basic fuchsin; with the acridine dyes such as acriflavine and proflavine; with Nile blue, malachite green, toluylene red, safranine, quinine, quinidine, cinchonine, cinchonidine, and hyamine 1622.

The reactivation of penicillin *in vivo* takes place not only with inorganic but also with organic salts. An intramuscular injection in a rabbit of 20,000 units/kg. of brilliant green penicillate produced a blood level of .16 units/cc. at 18 hours, and a similar injection of gentian violet penicillate, a blood level of .04 units at 18 hours.

A more detailed report will appear elsewhere.

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Inhibition of the Enzymatic Hydrolysis of ATP by Certain Cardiac Drugs[1]

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Although many investigations on the action of cardiac drugs have been carried out, only a few studies have dealt with their influence on the enzymatic reactions of heart muscle. Recently, however, Guerra, *et al.* (*2*) have reported that 1:10^6 ouabain increased the liberation of inorganic phosphorus from adenosine triphosphate (ATP) as catalyzed by a cardiac muscle myosin preparation.

As part of a systematic investigation of the action of certain glycosides on enzyme systems we were interested in the effect of these drugs on the energy-yielding enzymatic reactions in connection with the therapeutic and toxic actions of these substances. The effect of digitoxin and ouabain *in vitro* on the ATP-ase activity of cardiac muscle was, therefore, studied, and the present preliminary report indicates that both of these drugs affect this enzymatic reaction.

ATP-ase activity was measured by the method of DuBois and Potter (*1*) using a Klett-Summerson colorimeter for phosphorus measurements. Normal Sprague-Dawley rats averaging 200 grams were employed. Aqueous solutions of ouabain were added to give a final concentration of 6×10^{-5} M, and 10 per cent alcoholic solutions of digitoxin were added in amounts sufficient to give a final concentration of 4.7×10^{-6} M.

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[1] This work was supported by a grant from the Life Insurance Medical Research Fund and the Dr Wallace C. and Clara A. Abbott Memorial Fund of the University of Chicago.

[2] Lederle Laboratories Research Fellow.

In order to ascertain whether the action of the drugs was due to an action on the enzyme or on calcium, the activator for this enzyme, the effect of digitoxin was studied in the presence of suboptimal quantities and an excess of calcium. Table 1 shows the effect of varying amounts of calcium on the ATP-ase activity of normal rat's heart. It may be seen that with quantities of calcium below 0.003 M the reaction rate was limited by the calcium concentration. The results presented in Table 2 indicate that a final concentration of 4.7 × 10^{-6} M digitoxin inhibited the ATP-ase activity of cardiac muscle, the decrease in ATP-ase units being nearly the same, regardless of the calcium concentration. The per cent inhibition decreased with increasing calcium concentrations, since calcium increased both the control and digitoxin-treated samples to the same extent.

TABLE 1

RELATIONSHIP OF CALCIUM CONCENTRATION TO PER CENT STIMULATION OF ATP-ASE ACTIVITY

Molar $CaCl_2$	ATP-ase units	Stimulation (%)
1. 0.0003	14.20	66
2. (None)	8.54	
1. 0.0006	14.43	78
2. (None)	8.09	
1. 0.003	21.32	222
2. (None)	6.62	

TABLE 2

RELATIONSHIP OF DIGITOXIN (4.7 × 10^{-6} M) TO PER CENT INHIBITION OF ATP-ASE ACTIVITY

Molar $CaCl_2$	ATP-ase units		Decrease in ATP-ase units	Inhibition (%)
	Control	Drug		
1. 0.0003	14.20	11.09	3.11	21.90
2. 0.0006	14.43	11.64	2.79	19.33
3. 0.003	21.32	18.61	2.71	12.71

Ouabain also inhibited the ATP-ase system. In the presence of 0.003 M calcium, ouabain (6 × 10^{-6} M) produced 13.8 per cent inhibition. A higher concentration of ouabain than digitoxin was, therefore, necessary to produce a similar inhibitory effect.

These experiments indicate that both digitoxin and ouabain inhibit the ATP-ase activity of normal rat cardiac muscle. The amount of inhibition was independent of the calcium concentration, indicating that the drugs did not act through interference with the metallic activator. The difference in the per cent inhibition with various amounts of calcium indicates that the drugs inhibited a dephosphorylation reaction not dependent upon calcium ions for activity. With a limiting amount of calcium, an excess of ATP-ase is present in the test system to react with the drug, and less inhibition would be expected than in the case where the ATP-ase is limiting the reaction rate. The similarity in the decrease of ATP-ase units, regardless of whether calcium or ATP-ase was limiting the reaction rate, indicates that the drugs were inhibiting a dephosphorylation reaction not catalyzed by ATP-ase.

Further studies are necessary on other phosphatases in order to elucidate this inhibitory action of cardiac drugs.

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Creatinuria in Diabetics and an Evaluation of Methods for Determining Total Creatinine

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Diabetics exhibit an above-normal blood sugar, and when the blood sugar rises above the renal threshold there occurs a spilling of the sugar into the urine. In this disease the muscle glucose and glycogen are low and manifest a low tissue carbohydrate metabolism. It is probable that other metabolites present in these tissues in excess of the reduced metabolic requirements will also be found spilled into the urine.

Creatine plays a role in cellular metabolism and proliferation *(2)* as well as in muscular contraction *(4)*. A low muscle content of carbohydrate and creatine would account for a reduced metabolism and for the muscular fatigue and degeneration which follows the course of this disease.

Creatine found in the urine of a number of diabetic subjects of both sexes was determined by the method of Folin *(3)*. In Table 1 appears a summary of the average creatine spilled during 24 hours. In this series the low excretion of creatine was found to be 176 mg./day, and the high was approximately 1,600 mg./day.

TABLE 1

Age group	No. of subjects	Average creatine (mg./day)
32-37	3	487
43-48	21	670
50-53	18	790
32-53	42	649

Albanese and Wangerin *(1)* reported that in the Folin total creatinine determinations there occurs a decomposition loss of creatinine equivalent to 8 per cent when samples are autoclaved 20 minutes and 9 per cent when they are autoclaved 40 minutes. In order to obtain a more accurate creatine estimation in urine, they proposed a modification which involves autoclaving the standard as well as the preformed creatinine urine.

It seems to us that the loss of creatinine upon autoclaving does not appear to be great in view of the admitted error of ± 10 per cent in the technique involving an optical colorimeter. It is essential to determine in practice whether the Albanese modification will account for the loss of creatinine by the Folin method. By comparing identical samples of the autoclaved urine with the autoclaved as well as nonautoclaved standards of creatinine and creatinine zinc chloride, we will obtain indications of the direction and magnitude of the error in the Folin method. Any autoclaved urine sample should yield a lower creatinine level when compared with the nonautoclaved standard than when compared with the autoclaved standard.

One ml. of a 24-hr. specimen of urine was mixed with 20 ml. of a saturated picric acid and autoclaved for 20 minutes. The solution was then cooled, and 1.5 ml. of a 10 per cent NaOH solution was added. The mixture was allowed to stand 10 minutes, after which it was diluted to volume. The creatinine standards were dissolved in dilute HCl. One creatinine standard was autoclaved with picric acid; the other was not. All solutions were compared and read in a photoelectric colorimeter. A few samples of urine and creatinine standards were autoclaved 40 minutes. The results of the total creatinine found in the various urines are given in Table 2.

TABLE 2

Total Creatinine Determinations by Method of Albanese

Urine sample	Calculated from autoclaved (20 min.)		Calculated from nonautoclaved			
	Creatinine standard (mg./ml.)	Creatinine zinc chloride standard (mg./ml.)	Creatinine standard (mg./ml.)	Deviation (%)	Creatinine zinc chloride standard (mg./ml.)	Deviation (%)
(Autoclaved 20 min.)						
H 83	1.36	1.36	1.37	+0.7	1.33	−2.2
C 51	1.00	0.99	1.00	0.0	1.02	+3.0
K 13	0.88	0.88	0.89	+1.1	0.88	0.0
C 64	1.27	1.26	1.28	+0.8	1.33	+5.5
A 2	0.54	0.54	0.55	+1.8	0.55	+1.8
A 7	1.75	1.74	1.76	+0.6	1.77	+1.7
A 1	1.23	1.23	1.20	−2.4	1.20	−2.4
B 2	1.91	1.93	1.88	−1.5	1.87	−3.1
B 3	0.92	0.93	0.91	−1.1	0.91	−2.1
B 9	1.80	1.81	1.76	−2.2	1.76	−2.8
B 10	1.47	1.48	1.52	+3.4	1.52	+2.7
K 88	1.56	1.56	1.60	+2.5	1.60	+2.5
(Autoclaved 40 min.)	Standards autoclaved 40 min.					
A 1	1.17	1.17	1.18	+0.9	1.18	+0.9
B 2	1.83	1.83	1.85	+1.1	1.85	+1.1
B 3	0.89	0.89	0.90	+1.1	0.90	+1.1
8	1.31	1.31	1.30	−0.8	1.30	−0.8

The deviation in results obtained with a nonautoclaved creatinine standard as compared with an autoclaved standard varied from −2.4 to +3.4 per cent, and more than 50 per cent of the determinations were higher when compared with the nonautoclaved standards than when compared with the autoclaved standards.

Summary: Creatinuria was found in all 42 diabetic clinic subjects of both sexes taken at random.

Total creatinine determined in the urines of diabetics by the Albanese modification showed a variable deviation (in magnitude and direction) when compared with total creatinine obtained by the Folin method.

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Interpretation of Lignin: The Synthesis of Gymnosperm Lignin

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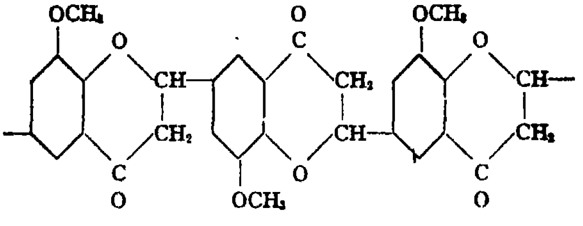
The existence of at least two varieties of lignin appears to be definitely established. One is associated with gymnosperms and gives, as significant fission products, only derivatives of catechol monomethyl ether (guaiacol). The other is associated with angiosperms and gives, as significant cleavage products, the same derivatives of catechol monomethyl ether and also some derivatives of pyrogallol-1,3-dimethyl ether. The possible occurrence of varieties of lignin giving other fission products is not excluded.

Examination of the analytical evidence accumulated during the past 70 years, excludes the improbable elaborate formulas previously proposed and leads to the conclusion that the lignin from gymnosperms is a polymeric 8-methoxy-dihydrobenzopyrone having the structure:



(I)

The lignin from angiosperms is likely constituted in a similar way but having pyrogallol-1,3-dimethyl ether nuclei terminally or otherwise attached or introduced. Such nuclei obviously could not replace directly the catechol monomethyl ether nuclei in (I) unless the migration of a methyl group occurs during degradation.

The material (I) is a cyclicized condensation (aldolization, loss of water—Claisen condensation) polymer of 2-hydroxy-3-methoxy-5-formylacetophenone (III) and is at once available by Fries rearrangement of vanillin monoacetate (II) through the steps (II) (III) (IV) (I).

This synthesis has been accomplished and the amorphous synthetic product, although somewhat darker in color, is qualitatively indistinguishable from a specimen of the lignin from gymnosperms. It has to give the same fission products, and its solubility characteristics and general behavior are the same. Moreover, absorption curves for the synthetic and the natural product are in agreement, and, so far as such comparisons are valid for amorphous materials, quantitative analytical measurements of the synthetic material and its derivatives are in harmony with calculated values and with the reported values for the lignin from gymnosperms.

For comparison purposes an exactly similar synthesis was carried out starting with p-acetoxybenzaldehyde. The product is analogous to that obtained from vanillin monoacetate.

It is to be noted that, in the above synthetic work, use has been made of a new type of polymerization reaction—the polymerization of a monomeric bifunctional ketoaldehyde. In these cases the reaction amounts to a condensation polymerization, but it could, in other cases, be an addition process.

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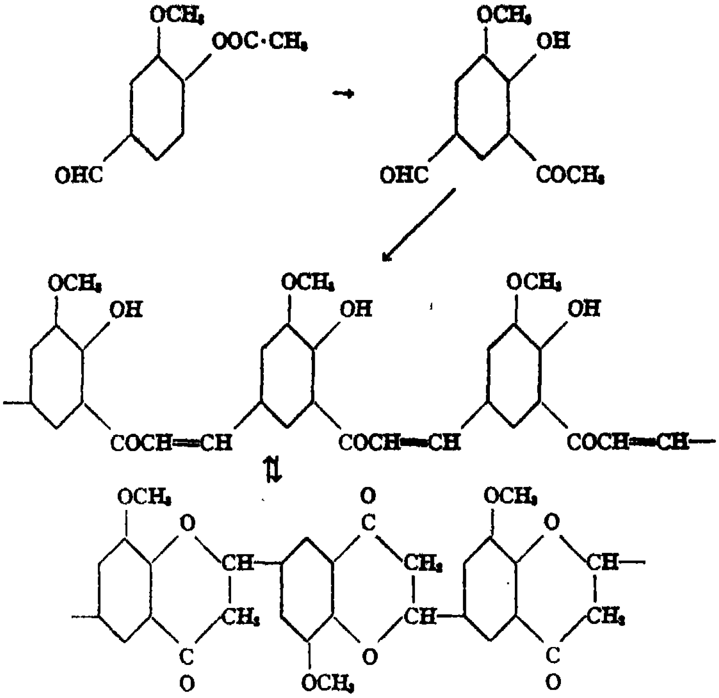
(II)

(III)

(IV)

(I)



If water solubility were achieved by having enough phenolic hydroxyl groups present, materials built on the polydihydrobenzopyrone model would likely have tanning properties. It is conceivable that natural phlobatannins have just such a structure.

A detailed report of this work will appear elsewhere.

IN THE LABORATORY

Ortho-Hydroxyphenylacetic Acid From an Amorphous Penicillin

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Recently Welch, Randall, and Price (*6*) have directed the interest of antibiotic investigators toward the significance of some impurities in certain batches of amorphous commercial penicillin. By means of a biological assay technique (*7*) which they developed these investigators were able to determine the presence of a nonpenicillin component which enhanced the activity of crystalline penicillin. Hobby, Burkhardt, Hyman, and Levert (*4*) have also demonstrated the presence of an enhancement factor in certain lots of impure penicillin.

This laboratory undertook the task of isolating and identifying the constituents in a batch of the amorphous commercial penicillin in which Welch, *et al.* had found the enhancement factor.

Since the material described by Welch, *et al.* as containing the enhancement factor was shown to be acidic by these authors, and in view of our previous results in the application of partition chromatography to the resolution of the penicillins (*2*, *3*), this technique was applied to the present problem. An investigation of numerous buffer and solvent systems finally resulted in the use of the subsequent conditions as the method of choice.

The crude penicillin was extracted four times at room temperature from an aqueous pH 2 buffer solution into ether, and the combined ethereal phases were evaporated to dryness, thus destroying any penicillin present. The residue was taken up in chloroform and added to a prepared chromatographic column in which silicic acid was the adsorbent and a 20 per cent potassium phosphate buffer of pH 3.6 the immobile solvent. The precautions mentioned in an earlier report (*2*) were followed in the preparation of the column. The chromatographic fractions subsequently referred to include the colorless as well as the colored zones on the column. With chloroform as the initial mobile solvent, 10 zones were eluted from the column. Ether was then substituted as the mobile solvent, and two additional bands were collected. Finally, an ether-butanol mixture (9:1) resulted in the development of two more zones. Each of the above fractions was analyzed by Welch, Randall, and Price (*7*) by their method for ascertaining the presence of the enhancement factor. A small amount of enhancement was exhibited in the third fraction, but the major portion was found in fractions 9 through 12.

TABLE 1

	Unknown	p-Hydroxy-phenylacetic acid	o-Hydroxy-phenylacetic acid
$FeCl_3$, test for phenols	Violet	Light green	Violet
M. P.	149–150° C.	150° C.	149–150° C.
Neut. equiv	150.2–151.6	152.06	152.06
M. P. of methyl ether	124	85–86	124
Methyl ester	71–71.5	Oil	71.0

Mixed M. P. of unknown and p-hydroxyphenylacetic acid, 122–135° C.; of o-hydroxyphenylacetic acid and p-hydroxyphenylacetic acid, 122–135° C.; of unknown and o-hydroxyphenylacetic acid, 148° C.

Anal. Calculated for $C_8H_8O_3$: C, 63.15; H, 5.30. *Found:* C, 62.95; H, 5.78.

Sufficient quantities of fractions 9 through 12 were prepared for the purpose of purifying and identifying the active principle. After evaporation of the solvent the residues were all glass-like and varied from an amber to dark reddish-brown color. Crystallization was effected by dissolving the free acid in a minimum amount of ether and adding enough benzene or petroleum ether to bring the system to a point just short of precipitation or, if precipitation occurred, the mixture was heated slightly to clarify and crystallization initiated at room temperature. Depending on the type of crystallization employed, either needles or rosettes of needle-like crystals were recovered. A series of recrystallizations were required in order to achieve clean, white crystals exhibiting a sharp melting point at 149–150°C. From the physical and chemical tests to which the unknown and derivatives of the unknown were subjected, it became evident that either p- or o-hydroxyphenylacetic acid was the compound involved. A sample of p-hydroxyphenylacetic acid was obtained through the courtesy of Chas. Pfizer & Company, and a sample of o-hydroxyphenylacetic acid was synthesized in this laboratory. These two compounds and their derivatives were compared with the unknown and its derivatives. The data in Tables 1 and 2 demonstrate conclusively that the crystalline component separated from the active fraction of the crude penicillin used is o-hydroxyphenylacetic acid.

TABLE 2

INFRARED DATA

(Absorption Bands in Microns)

Unknown	o-Hydroxyphenylacetic acid	p-Hydroxyphenylacetic acid
13.75	13.75	12.60
13.18	13.18	12.10
11.75	11.75	11.95
11.42	11.42	11.62
10.60	10.60	11.09
10.32	10.32	10.41
7.85	7.85	9.80

For the sake of brevity only the significant differences between the absorption bands of o- and p-hydroxyphenylacetic acids in the infrared are included in Table 2. The compounds were mascerated in mineral oil and the mixture analyzed in a Perkin-Elmer infrared spectrophotometer.

The o-hydroxyphenylacetic acid was prepared by a modification (*5*) of the procedure of Czaplicki, von Kostanecki, and Lampe (*1*). Preliminary experiments with o-hydroxyphenylacetic acid have not conclusively demonstrated an enhancement effect on the penicillin blood levels. These studies by Welch, *et al.* are being continued

Studies are now in progress toward the isolation and identification of the component in active "fraction 3."

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The Laboratory Preparation of Mustard Gas

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The current interest in mustard gas in producing gene mutations suggests the desirability of describing a convenient procedure for making and handling this material. Because of shipping restrictions it is easier to make mustard in the laboratory than to buy it. The wide variation in susceptibility to mustard between individuals or in the same individual after repeated exposures makes the handling of the material an important consideration.

Mustard can conveniently be prepared by warming ββ'-dihydroxy ethyl sulfide (Eastman Kodak No. T1224) with concentrated hydrochloric acid. The reaction can be followed by observing the separation of a heavy oil which settles to the bottom. In practice we have used a large excess of acid in order to drive the reaction to completion. Twenty-five ml. of the ββ'-dihydroxy ethyl sulfide may be heated with 75 ml. of concentrated hydrochloric acid at 60° C. for 30 minutes. A longer time will do no harm. The aqueous layer is then poured off, the oil being washed rapidly with a little distilled water and transferred to a storage bottle. This preparation should be carried out in a hood with good ventilation, the aqueous layer poured into a cream of bleaching powder to destroy any mustard, and the hands washed promptly with bleaching powder to remove any mustard absorbed from the gas phase.

The flask shown in Fig. 1 is convenient for storing, since it permits one to remove a sample without contaminating the air of the laboratory from the storage flask. If an aspirator is turned on before the first stopper is taken out, the downcurrent of air will sweep away any mustard diffusing out of the flask when the second stopper is removed. We have used cork stoppers covered with metal foil, since mustard is readily absorbed by rubber. In fact, rubber tubing will completely remove mustard from an air stream, only to give it off later when the tube is more or less saturated.

The easiest way to obtain a given partial pressure of mustard in an air stream is probably to make a saturator by taking a U-tube, inserting a folded filter paper in each arm in such a way as to give a large surface, and then pouring in enough mustard to dampen the filter paper by capillary rise. This U-tube can then be put in a beaker of water of any desired temperature below room temperature to give the desired partial pressure. We have recently submitted to the *Journal of the American Chemical Society* an article giving vapor pressure data on mustard which fit the equation $\log_{10}p = 9.4819 - 3117.2/(t + 273.1)$, in which p is the vapor pressure in millimeters and t is the centigrade temperature.

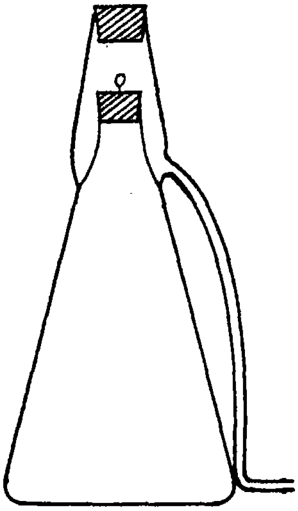

FIG. 1

Oxidation of β-Carotene With Osmium Tetroxide

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The successful oxidation of carotene at the central double bond to form vitamin A aldehyde, accomplished by Hunter and Williams (*3*) using hydrogen peroxide, indicated that a catalyst was necessary to improve their low yield (0.5 per cent). Osmium tetroxide, used by Criegee (*1*) for the oxidation of anethole and other ethylenic compounds, seemed to have the characteristics of being such a substance, since, with hydrogen peroxide, both aldehydes and glycols are formed (*4*).

If one of the central double bonds can be formed into the epioxide simultaneously with formation of a diglycol at the other, then the resulting compound is identical with the postulated intermediate of the Cannizzaro reaction. This, according to Fredenhagen and Bonhoeffer (*2*), undergoes rearrangement prior to fission, which would account for β-carotene having half the biological value of vitamin A by weight, and corresponding lower values for other provitamin A compounds.

In applying the reaction of Criegee it has been found that a 1 per cent ethereal solution of osmium tetroxide cannot be prepared from the solid and kept, as it is all reduced in a few hours. An aqueous solution has therefore been employed. Similarly, 30 per cent hydrogen peroxide (aqueous) has been used, although in both cases the reaction proceeds faster with a slightly higher yield if the solutions used are anhydrous in the initial stages.

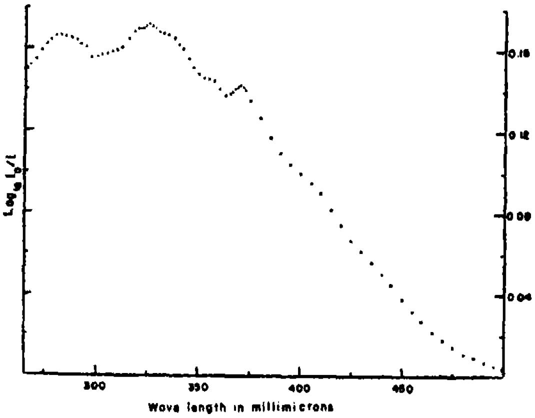

FIG. 1. Absorption curve of oxidation products of β-carotene in cyclohexane.

This work is still in progress, and the details will be published at a later date. However, a typical set of conditions for the reaction is as follows:

About 10 grams of anhydrous sodium sulfate is introduced into a 500-ml., three-necked flask fitted with a reflux condenser, a sealed stirrer, and a burette. For the initial stages the reflux condenser should be fitted with a loosely packed, calcium chloride drying tube. A 50-ml. aliquot of a solution of carotene (90 per cent β- and 10 per cent α-carotene) in anhydrous, alcohol-free ethyl ether is run in from the burette, followed by 1 ml. of a 2 per cent aqueous solution of osmium tetroxide, the solution is stirred for 5 minutes or until a color change is observed, and 2 ml. of 30 per cent hydrogen peroxide is then introduced dropwise. The solution is stirred for 10 minutes, 3 ml. of a 0.5M sodium bicarbonate solution is added slowly, and the stirring is continued until there is no further effervescence. A mixture of 50 ml. of 95 per cent ethyl alcohol and 5 ml. of 50 per cent potassium hydroxide solution is added. The solution is stirred for a further 10 minutes, then decanted into a 500-ml. separatory funnel, and 50 ml. of ethyl ether is added. The funnel is then shaken thoroughly, the lower layer run off, and the supernatant washed as in vitamin A analysis.

An aliquot of the resulting solution is dried over anhydrous sodium sulfate, evaporated under reduced pressure, and taken up in cyclohexane. The absorption spectrum of this solution shows maxima at 283, 325, and 370 mμ (Fig. 1). If the intensity of the blue color with antimony trichloride, measured at 620 mμ, is due to vitamin A, the yield is 30–40 per cent of the theoretical conversion of β-carotene to vitamin A.

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An Improved Electromagnetic Sphygmograph[1]

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The apparatus described here is a technical improvement of the Electromagnetic Sphygmograph previously described by the authors (*1*), but differs in two important respects: (1) the use of a dynamic speaker magnet in the recording unit and (2) the placement of a variable resistor in series with the microphone. These improvements make for greater stability of the apparatus and make it possible to obtain sphygmograms of practically any desired amplification and clarity.

A 200-ohm, single-button, Model W carbon granule microphone, described previously (*1*) and manufactured by Universal Microphone Company, Inglewood, California (Fig. 2,7), has a light aluminum knob fastened to the diaphragm by Duco cement. This knob, when placed on any superficial artery, serves to transmit to the diaphragm the fluctuations in pressure of the pulse-pressure waves. Since the internal resistance of the microphone varies with the pressures exerted on the diaphragm, the fluctuations in pressure caused by the pulse beat are converted into corresponding fluctuations of resistance. Since the current through the microphone is a function of its internal resistance, in accordance with Ohm's law, I = E/R, the fluctuations of pressure are ultimately converted into corresponding pulsations of current. The voice coil of a 20-watt dynamic speaker, consisting of 25 turns of #28 enameled wire (Fig. 1, 1; Fig. 2, 1), is connected in series with the microphone. As shown in Fig. 2, the pulsating current passes through the movable coil, suspended in the magnetic field of a *dynamic speaker magnet* (Fig. 1, 3) by means of three adjustable radial supports (Fig. 1, 2). The possibility of using a permanent magnet speaker field suggests itself here.

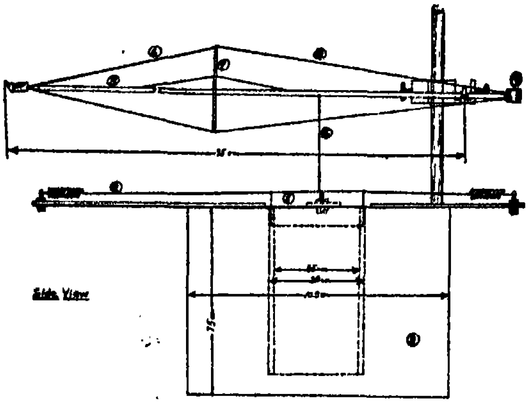

FIG. 1. The improved Electromagnetic Sphygmograph: (1) movable coil —25 turns of #28 enameled wire; (2) flexible radial support with adjustable spring tension; (3) dynamic speaker magnet; (4) stiff connecting wire; (5) wood heart lever; (6, 7, 8) stiffening members; (9) adjustable counterbalance.

The pulsations of current cause the movable coil to move up and down through the magnetic field of the speaker magnet by an amount which is at any time directly proportional to the pressure the artery is exerting, through the layers of surrounding tissues, upon the diaphragm of the microphone. The movements of the coil are transmitted by a stiff wire (Fig. 1, 4) to a trussed heart lever (Fig. 1, 5) equipped with an adjustable counterbalance (Fig. 1, 9), which then accurately transcribes the movements of the artery on an ordinary kymograph drum.

In order to regulate the strength of the current flowing through the movable coil, a *variable resistor* (Fig. 2, 2) is placed in series with the microphone-movable coil circuit. The amplitude of the recording can be regulated by varying the resistance. Ideal records for all subjects tested were obtained with the resistor set at values from 50 to 200 ohms when the system is used in conjunction with a 6-volt battery (Fig. 2, 5).

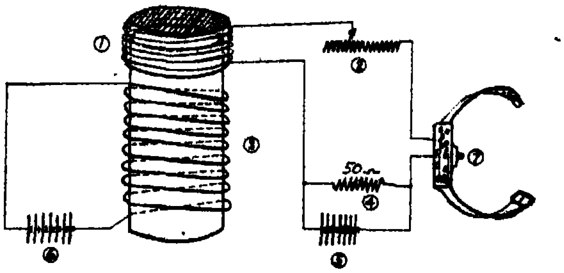

FIG. 2. Wiring plan: (1) movable coil; (2) variable resistance in series; (3) radial field winding and core; (4) 50-ohm damping resistance in parallel; (5) battery for microphone and movable coil circuit; (6) battery for field circuit; (7) microphone with adjustable straps.

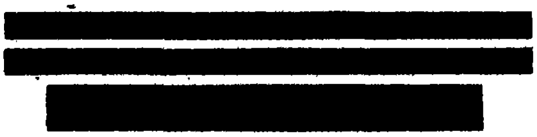

FIG. 3. Typical sphygmograms: top to bottom—normal radial, normal carotid, normal radial (strong amplification).

A 50-ohm damping resistor (Fig. 2, 4) is placed in parallel with the microphone circuit in order to assure a "dead beat movement" of the coil and hence a "damping down" of the rebounds of the writing lever. Both the field magnet and the microphone-coil circuit are energized by an ordinary 6-volt, wet-cell battery or, preferably, separate batteries should be used for each circuit, as shown in Fig. 2, 5, 6.

As seen from the sphygmograms (Fig. 3), clear and well-defined transcriptions of practically any desired amplitude may be obtained with this apparatus from the carotid, radial, or any of the other superficially located arteries.

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[1] From a paper read by Baldwin before a section meeting of the Society for Experimental Biology and Medicine, San Diego, June 1947.

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[3] The assistance and cooperation of R. E. Vollrath, of the Department of Physics, is gratefully acknowledged.

Book Reviews

A new notation and enumeration system for organic compounds. G. Malcolm Dyson. New York-London-Toronto: Longmans, Green, 1947. Pp. iv + 63. $1.75.

This monograph presents the fundamental portions of a new notation which, in the words of the author, "may go far towards advancing those difficulties of chemical nomenclature that, as chemistry advances, become more apparent each year, particularly in classification and indexing. . . . The scheme was first formulated in 1944, and various tests were carried out to ascertain, as far as could be done at that time, the general validity of the system. The Ring Index was completely ciphered into the new notation, and it was found that there was no single entry which did not give a unique and unequivocal cipher. Five volumes of Beilstein were ciphered into the new notation, and these have been collated and arranged in cipher-index order; and in no case did the system fail to provide a satisfactory delineation."

Complete details are given for translating organic compounds into the appropriate cipher. The compounds covered include: hydrocarbons, alcohols, glycols, and phenols; ethers; epoxy compounds; aldehydes and ketones; quinones; carboxylic acids; carboxylic esters; lactones; heterocyclic compounds; amines; acid amides, halides, and anhydrides; nitroso, nitro, and azido compounds; ureas, urethanes, etc.; azo compounds; hydrazines, oximes, etc.; halogens; sulfur compounds; phosphorus compounds; carbohydrates; and polysaccharides. In the appendix are given ciphers for some steroids (adrenal) steroids (general), aporphine alkaloids, morphine alkaloids, and fused rings. Included also are ciphers for compounds numbered 2401 to 2700 in the Ring Index.

Acyclic and alicyclic hydrocarbons are all delineated in terms of 6 symbols, as follows: C, carbon; E, double bond; E_1, cis arrangement at the double bond; E_2, trans arrangement at the double bond; E_3, triple bond; A, bridge or ring. The number following the letter C gives the number of carbon atoms in the longest straight carbon chain in the molecule. The cipher for 2,2-dimethyl-5-methyl-7-propyldecane is C10.4C3.6C2.9,9C. For 1,3-butadiene, the cipher is C4.1,3E. Cycloparaffin rings are denoted by the letter A, as AC4 for cyclobutane, AC5 for cyclopentane, AC6 for cyclohexane, etc. Cyclohexane with a bridge-link in the 1-3 position is AC6.1-3A. Cyclooctane with two bridge-links, in the 1-5 and 3-7 positions, each bridge comprising a single methylene group, is AC8.1-5,3-7AC.

All aromatic and fused rings are ciphered in terms of the following conventional rings: V, cyclopentadienyl; B, benzene; W, indenyl; K, naphthalene; J, phenanthrene; T, anthracene. Other fused rings are derived from these 6 fundamental rings by the addition of fragments of the benzene ring or of saturated chains. The fragments are called adducts. For example, the Beilstein notation, 4′.4″.Dimethyl-(dibenzo-1′.2′:2.3;1″.-2″:6.7 phenanthrene) becomes T9.6,21C.

The Dyson system is readily applicable to punched-card manipulation, is well suited for indexing purposes, but appears to have some limitations with regard to classification purposes. The accuracy of any cipher can be checked independently by computing the molecular formula from the cipher, using constants supplied by the author.

The Dyson cipher is an important contribution in the field of indexing and classifying compounds, and those concerned with this type of work should familiarize themselves with this system so that all possible advantage may be taken of it.

FREDERICK D. ROSSINI
National Bureau of Standards

Psychiatric research. C. K. Drinker, J. Folch, S. Cobb, H. S. Gasser, W. Penfield, and E. A. Strecker. Cambridge, Mass.: Harvard Univ. Press, 1947. Pp. 113. (Illustrated.) $2.00.

This slender book is a very stimulating and timely collection of addresses prepared by six distinguished scientists. These were presented originally at the dedication of the Laboratory for Biochemical Research at the McLean Hospital on May 17, 1946. Opened in 1818, the McLean was the first institution for the care of the mentally ill in Massachusetts. Rufus Wyman was chosen by the Trustees of the Massachusetts General Hospital as its first director. The institution became outstanding for leadership in psychiatric care, and its research program did much to advance the field of scientific psychiatry. A paper by Cecil K. Drinker on "Research at the McLean Hospital" gives a concise review of the steps which there advanced psychiatric treatment and the research accomplished. The second paper, "Biochemical Problems Related to Psychiatry," is by Jordi Folch, director of scientific research at the McLean. Here is presented a thoroughgoing survey of brain function from the biochemical viewpoint, with special emphasis on problems which the author feels have been hitherto sometimes neglected. This discussion should be particularly useful to students entering this field. It includes some tabular material and provides a bibliography of 65 references.

The address by Stanley Cobb, entitled "Integration of Medical and Psychiatric Problems," presents a report of the psychiatric service at the Massachusetts General Hospital during the last five years. A new psychiatric ward was opened in 1941; and findings are reviewed for a group of 843 typical patients. The discussion concerns methods of treatment and typical outlines of laboratory investigations. A study of neurocirculatory asthenia is presented as an example of work in a problem field where integration between internal medicine and psychiatry has borne fruit in clinical investigations. The paper has a bibliography of 42 references.

The fourth chapter, entitled "Protocol for a Review of Psychiatry," by Herbert S. Gasser, will doubtless be provocative of much discussion. Propounding the theory that all of the sciences might have in common a strict type of language as exact as the language of physics, Dr. Gasser discusses the problem of bridging the hypothetical chasm in observation and semantics between the so-called natural and psychological sciences. He assumes that "as parts of science, psychiatry and neurophysiology differ no more than their coefficients of complexity." Not infrequently in psychiatric writings a single sentence may contain a combination of nonintertranslatable terms from two languages: the language of the psyche and that of physics. Dr. Gasser asks whether the science of psychiatry might not develop most rapidly if its reports were so phrased as to bypass areas in which observation and subsequent exact communication have not so far been achieved. A brief review statement can hardly do justice to this chapter.

A chapter on "Psychical Seizures" by Wilder Penfield gives the clinical histories of some of his patients in an illuminating and well-illustrated review. This eminent specialist convincingly develops the view that many new fields of treatment would be open to the surgeon if he could but understand the nature of the problems and secure the cooperation of understanding colleagues in his own and related areas.

The final chapter by Edward A. Strecker, on "The Psychobiology of Psychiatric Research," presents psychiatric research as itself an organism passing through various mood-swings and changes of attitude and gradually making more and more satisfactory adjustments to the realities of mental disease.

The general tenor of all six addresses is forward-looking and constructive. The present reviewer closed the book with the strengthened conviction that psychiatry as a psychological science is destined to play a positive and important part in man's happier life adjustments. All the contributors to the present symposium have emphasized the point of view that progress in psychiatry will be made more effectively as this discipline becomes more soundly scientific. These contributions are blueprints that may well serve as guides to constructive scientific development.

This volume, published as No. 9 in the series of "Harvard University Monographs in Medicine and Public Health," is to be highly recommended for students in psychiatry and psychology and also for the more general reader.

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Scientific Book Register

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CONANT, JAMES BRYANT, and BLATT, ALBERT HAROLD. *The chemistry of organic compounds: a year's course in organic chemistry.* (3rd ed.) New York: Macmillan, 1947. Pp. viii + 665. $5.00.

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GILLIN, JOHN. *Moche, a Peruvian coastal community.* (Institute of Social Anthropology, Publ. No. 3.) Washington, D. C.: Smithsonian Institution, 1947. Pp. vii + 166. (Illustrated.) $1.00.

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LOEB, LEONARD B. *Fundamentals of electricity and magnetism.* (3rd ed.) New York: John Wiley; London: Chapman & Hall, 1947. Pp. xix + 669. (Illustrated.) $6.00.

OLDHAM, FRANCES K., KELSEY, F. E., and GEILING, E. M. K. *Essentials of pharmacology.* Philadelphia-London-Montreal: J. B. Lippincott, 1947. Pp. xiv + 440. $5.00.

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THIESMEYER, LINCOLN R., and BURCHARD, JOHN E. *Combat scientists.* (Ed. by Alan T. Waterman.) (Science in World War II, OSRD.) Boston: Little, Brown, 1947. Pp. xviii + 412. (Illustrated.) $5.00.

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Genetic Control of Lymphomatosis in the Fowl

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AVIAN LYMPHOMATOSIS IS A DISEASE characterized by the accumulation of undifferentiated lymphocytes in the nerves, in the viscera, or in the iris. If the resultant tumors are in the sciatic or brachial nerves, the leg or wing is paralyzed, and the bird is incapacitated even though otherwise in good health. In many cases nerves of the autonomic system are affected. Involvement of the ovary, liver, spleen, and kidney is common.

The disease is known—in its various forms, and by different people—as lymphomatosis, neurolymphomatosis, leukemia, the avian leucosis complex, iritis, fowl paralysis, range paralysis (because it often afflicts young birds on the rearing ranges), and big-liver disease. In Europe, it is sometimes called Marek's disease after the Hungarian pathologist who first described it in 1907. It is prevalent in many parts of the world.

Because under certain conditions lymphomatosis can be transmitted from bird to bird by inoculation with a cell-free filtrate from diseased fowls, it is generally considered to be caused by a virus. It is also spread by contact among young chickens.

The disease usually does not cause death before 6 weeks of age, but most of the susceptible birds die within 18 months of hatching. In the United States it is responsible (*4*, *17*) for about 40 per cent of the high mortality now prevailing in growing stock and during the first year of life. Since the first detailed study of the disease in this country by Pappenheimer, Dunn, and Cone (*13*), many investigators have sought to discover its cause, the paths of infection, the basis for the diverse manifestations, and possible methods of control. That progress in these directions has been slow is disappointing to the poultry industry, but not surprising to anyone familiar with the difficulties besetting any study of neoplasia.

A special laboratory for research on avian lymphomatosis was established by the U. S. Department of Agriculture in 1939 at East Lansing, Michigan. The director of that laboratory, Berley Winton, has estimated (*17*) that the disease causes in this country alone an annual loss exceeding $50,000,000.

That the disease may be effectively controlled by raising the chicks from hatching to about 5 months of age in complete isolation from older birds was proved experimentally by Kennard and Chamberlin (*10*) and by Johnston and Wilson (*9*). After about 5 months of age, exposure to the disease seems not to matter. However, it is not possible for many poultrymen to provide separate attendants and equipment for their growing stock; hence, complete isolation is somewhat impracticable. Losses from lymphomatosis can still be reduced with lesser and more feasible degrees of isolation, particularly if the chicks be kept at some distance from older stock during the first few weeks after hatching, which is apparently the critical period (*6*).

THE EXPERIMENT

Object. Beginning with an unselected population hatched in 1935, an experiment has been carried out at Cornell University to determine the feasibility of breeding strains of fowls resistant to lymphomatosis. It was well known then that families differed in susceptibility (*1*). The question was whether or not, by selection, genetic resistance could be established at a level high enough to constitute control of the disease in large populations that are thoroughly exposed, *i.e.* in commercial poultry flocks. Furthermore, resistant strains would be of little economic value unless superior (or satisfactory, at least) in body size, in egg production, and in egg size. It was desirable, therefore, to determine whether or not increased resistance to lymphomatosis could be attained without sacrificing these other indispensable desiderata.

Procedure. Reduced to its simplest terms, the procedure for 12 years has been (a) to have all chicks pedigreed, so that the sire and dam are known for each, (b) to ensure a natural exposure to lymphomatosis, (c) to maintain, as nearly as possible, uniform environment for all birds at every age from the egg on, and (d) to select for breeding the sires and dams whose production of the most resistant families has been proved, together with promising untested birds from those same families.

Some idea of the scope of the experiment is given by the fact that, in all selected generations after the fourth (which was hatched in 1939), from 2,100 to 2,600 females of the White Leghorn breed have been started at 6 weeks of age in tests of their viability and have been maintained under test to the age of 500 days. Complete records have been kept of their ages at commencement of laying, of their egg production, size of egg, and body size.

Every bird that died was autopsied to ascertain the cause of death. The usual thorough macroscopic examination was supplemented, when necessary, with bacteriological study, or with histological examination to determine the type of tumor involved. Most of these diagnoses were made by one of us (R.K.C.), except for a period of 46 months when he was absent in military service. During that time the examinations were made by R. F. Ball, whose assistance is gratefully acknowledged.

An essential part of the program was that no birds were culled from the flock because of small size, low egg production, or ill health. Some whole families were eliminated when the numbers of female chicks therein were too small to permit evaluation of the family's genetic potentialities, but this was done early, before the test had progressed very far. Once started, all birds were given an equal chance to demonstrate their ability to survive to 500 days of age. This does not mean that every hen still able to stagger about at that age was counted as a survivor. On the contrary, all birds then obviously sick were killed and examined, and their records were included with those of birds deceased earlier.

Full details of the procedure and management have been given in interim reports (*5–8*). Anyone comparing the data in these reports with figures in the present paper should remember that, whereas the former analyses considered a test period beginning at 160 days of age, records for the early years have now been extended to include the period from 6 weeks to 500 days.

Strains involved: The flock of White Leghorns with which the experiment was begun had been bred at Cornell University for many years for increased egg production, but no selection had been made for resistance to disease, except in so far as the least fit had eliminated themselves from the breeding pens by premature death. From this stock, three differing strains have been developed. One of these, the C Resistant line, has had no new blood introduced. Another, the K Resistant line, comes from an outcross of the original Leghorns to an entirely unrelated line in 1936. The third strain, the Susceptible line, has come from the original stock but has been bred for susceptibility to lymphomatosis.

Exposure. The birds under test have been exposed naturally, not inoculated with pathogenic material. When the experiment was started, little was known of the transmission of the disease or of the channels of infection. However, from its prevalence in this flock and in others, it was assumed that natural exposure adequate for differentiation of resistant and susceptible families (and hence for selection) was inevitable. It seemed preferable to breed for resistance to that type of infection rather than to some aberrant pathological condition that might result from artificial inoculation. This decision was fortunate, for it has subsequently been shown that genetic resistance to natural infection is not revealed by subcutaneous inoculation (*3*) or by inoculation in some manner not specified (*18*), although oral inoculation does permit differentiation of genetically resistant and susceptible stock (*3*).

To ensure adequate natural exposure, sanitation of the kind so generally advocated was practically dispensed with. Brooder houses, rearing quarters, and laying pens were cleaned when necessary but were not disinfected. Trucks, equipment, feed, and attendants moved freely from buildings housing adult birds to the rearing range. Chicks were managed during the critical first two weeks after hatching by an attendant who also cared for adult birds and whose work was so arranged that he walked many times daily from hen-pens to chick-pens.

Proof that natural exposure was ample in this experiment was provided by the high incidence of lymphomatosis among birds of the Susceptible strain. Since these were hatched along with those of the C and K Resistant strains, and mixed with them right from the incubators onward, it is obvious that all must have been equally exposed. In similar selection experiments conducted by others, failure to maintain such a susceptible strain has led to the erroneous belief that strains resistant to lymphomatosis had been quickly established when (as the experience in later years showed) they had merely been temporarily relieved from severe exposure.

RESULTS

(A) *Neoplasms*. As is shown in Fig. 1, the selection practiced was effective in differentiating two lines highly resistant to neoplasms and one that was very susceptible. Of the neoplasms, 90–95 per cent were cases of lymphomatosis, but, because there was at one time disagreement among pathologists concerning the different manifestations of this disease, the all-inclusive term, neoplasms, was used from the very beginning of the experiment.

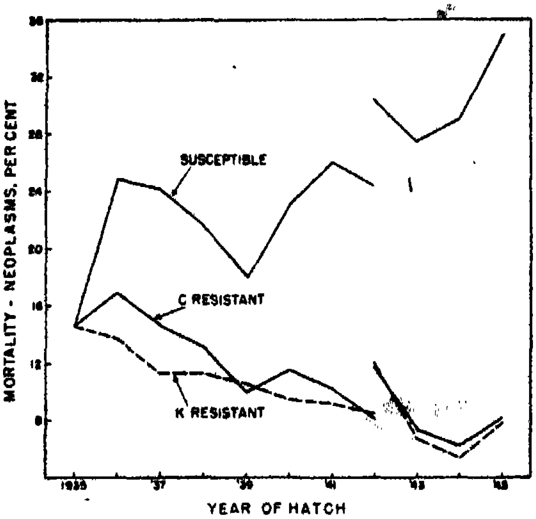

FIG. 1. Reduction in deaths from neoplasms in the C and K Resistant lines and increase in the Susceptible line during 10 generations of selection. The graphs are smoothed by using a 3-year moving average (except for terminal points). The break in 1942 is explained in the text.

In the unselected population of 1935, 14.6 per cent died of neoplasms. In the 9th and 10th selected generations, hatched in 1944 and 1945, deaths from neoplasms in the K Resistant line were 5.4 and 7.9 per cent, respectively, and in the C Resistant line they were 6.3 and 8.3 per cent.

The reduction of neoplasms in these two lines is much more significant than the figures indicate. In 1942 it was discovered that one of the two brooder houses used was providing a much more severe exposure than the other, possibly because of its closer proximity to adult fowls. Even though chicks were brooded in that house for only their first two weeks, they suffered over twice as many deaths from neoplasms after 5 months of age as did the chicks started in the other house (*6*). This effect is clearly shown in Fig. 1, in the data for 1942. In all three strains, the lower points for that year show, as for previous years, the deaths from neoplasms in all birds. Half of these were lightly exposed and half severely exposed. The upper points give the corresponding figures for the severely-exposed birds only. Since, in the two resistant lines, these latter figures are about 50 per cent higher than the average, it is evident that the other half of the birds was exposed rather lightly. This condition had prevailed, unknown, from the start of the experiment in 1935. After its discovery, all the chicks were started in the brooder house providing the severe exposure. That deaths from neoplasms in the two resistant lines were only 5–8 per cent in the 1944 and 1945 populations is more significant, therefore, than one might think at first glance.

Over the 10-year period of selection, deaths from neoplasms in the Susceptible line increased gradually. This is remarkable, because selection is less efficient in that line than in the others. Since the most susceptible birds die long before the normal breeding season, selection is limited to the use of the remaining birds (which are the more resistant ones) in the susceptible families. In spite of this, susceptibility was raised in the 10th generation to such a level that 34.9 per cent of the females in the Susceptible line died of neoplasms before 500 days of age. This figure was over four times those for the two resistant strains.

The foregoing data on mortality from neoplasms are based on the total populations in each line each year. Each of these groups can be divided into two classes: (a) daughters of proven sires, and (b) daughters of cockerels being tested for the first time. One might reasonably consider only the former class as the measure of the progress effected by selective breeding, as it is inevitable that some cockerels will fail to transmit in accord with the breeder's hopes and expectations. For this reason, the record for all daughters of proven sires is somewhat better than that for all daughters of cockerels and, hence, better than the averages for the strains shown in Fig. 1.

Considering now only the daughters of proven sires, selection has raised resistance to a level such that in the C and K lines deaths from neoplasms were only 2.0 and 4.4 per cent, respectively (during the 458-day test period), for the 9th generation and 6.6 and 7 per cent for the 10th generation. Exposure to the disease was severe enough to cause 34 and 38 per cent of the birds in the Susceptible line to die of neoplasms in those same years. These losses in the two resistant lines are so low as to be relatively unimportant.

(B) *Mortality from all causes.* The reduction of economic loss from mortality in the two genetically resistant strains is considerably greater than one would expect from the lowering of the death rate from neoplasms alone. In 1935, mortality from all causes during the test period was 66.8 per cent in the unselected population. In the 10th selected generation it had dropped to 22.4 per cent in the C Resistant line and 19.9 per cent in the K Resistant line (Fig. 2). These mortality rates mean a reduction of losses by about two-thirds.

Some of this reduction in mortality may properly be attributed to improvements in husbandry during the 10-year period, particularly to changes in management during the rearing period which reduced losses from coccidiosis and tapeworms. However, since total mortality in the Susceptible strain was still 53 per cent in the 10th generation, and as high as 68 per cent in the severely exposed pullets of the 7th generation (1942), it is clear that by far the greater part of the reduction of mortality in the resistant lines must be credited to breeding. Moreover, it is probable that potential deaths from lymphomatosis were actually higher in the earlier years of the experiment than the frequencies shown in Fig. 1. This is partly because many of the birds then died of intestinal parasites before an age at which they could show lymphomatosis. Moreover, some of the more obscure forms of the disease were probably not recognized in the earlier years.

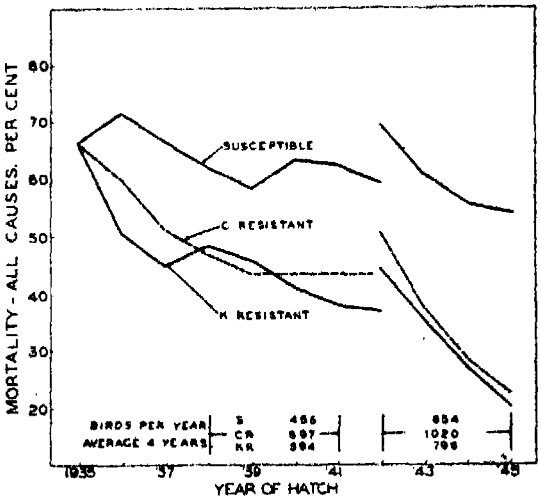

Fig. 2. Reduction in deaths from all causes in the resistant strains and maintenance of high mortality in the susceptible one. The lines show 3-year moving averages (except for terminal points).

It will be noted that between 1937 and 1942 mortality was not decreased much in the K strain and remained practically constant in the C strain. However, from 1942 onward it declined rapidly in both of these resistant lines. The reasons for this rather abrupt change in trend will be discussed later. The rise in mortality in all three lines in 1944 resulted from chronic respiratory disorders, which were unusually severe in that year.

(C) *Age at death.* Genetic differences in resistance to disease among these three strains are shown not only by the proportions that died during the test period but also by the duration of life. Since most of the birds surviving to 500 days (all not retained for breeding) were then disposed of, a true figure for mean duration of life cannot be determined. However, among those of the 10th selected generation dying prior to 500 days of age, birds in the K and C Resistant strains lived 71 and 39 days longer, respectively, than those that died in the Susceptible strain. For these last the mean age at death was 233 days.

(D) *Differences among families*. Since the original demonstration by Asmundson and Biely (*1*) that sires differ in the degree of susceptibility to lymphomatosis transmitted to their daughters, similar differences have been commented upon by others. Some striking cases were cited in an earlier report (*7*). Without going into voluminous details, some idea of the genetic variability in this respect (which is the basis for selection) is given by the data in Table 1. This shows the distribution of 86 cockerels of the 8th, 9th, and 10th generations according to the mortality in their daughters from neoplasms and from all causes. (Lymphomatosis accounted for about 90 per cent of the neoplasms.) Only sires that had at least 30 daughters under test are included; three-quarters of them had over 40, and almost half had over 50.

TABLE 1

DISTRIBUTIONS OF 86 COCKERELS TESTED IN 1943, 1944, AND 1945 ACCORDING TO MORTALITY IN THEIR DAUGHTERS (a) FROM NEOPLASMS, AND (b) FROM ALL CAUSES, BETWEEN 42 AND 500 DAYS OF AGE

(a) Mortality from neoplasms among daughters (%)	Sires in: C and K Resistant lines (No.)	Sires in: Susceptible line (No.)	(b) Mortality from all causes among daughters (%)	Sires in. C and K Resistant lines (No.)	Sires in. Susceptible line (No.)
0	5				
0.1–3	12		5 –10	1	
3.1–6	13		10.1–15	6	
6.1–9	19	1	15.1–20	8	
9.1–12	9		20.1–25	13	
12.1–15	3	1	25.1–30	11	1
15.1–18	2	2	30.1–35	8	1
18.1–21	1	3	35.1–40	7	1
21.1–24	1	2	40.1–45	8	2
24.1–27		1	45.1–50	2	6
27.1–30		3	50.1–55		4
30.1–33		2	55.1–60	1	1
33.1–36		2	60.1–65		
36.1–39		1	65.1–70		2
39.1–42		1	70.1–75		3
42.1–45		2			
Total......	65	21		65	21

Among the 65 sires of the Resistant lines, there were 5 that lost no daughters at all from neoplasms, and this in families of which the average size was 52. At the same time, 2 males of the Susceptible line each had 44 per cent of their daughters die of neoplasms. Three of the 21 cockerels in that strain lost over 70 per cent of their daughters from all causes before 500 days of age. These cases from opposite extremes, and the range shown in Table 1, give some idea of the variation available for selection and also of the differentiation between resistant and susceptible lines brought about by that process.

When a sire's genotype has once been evaluated by an adequate progeny test, fairly consistent performance of his offspring by comparable females can be expected thereafter. This is illustrated by the records for 2 males, both of which were used for 3 consecutive years. Though mated with different females each year, deaths of daughters from neoplasms in those years were 4.3, 1.5, and 0 per cent for one sire, but 33, 47, and 41 per cent for the other. While the difference must be attributed in part to the fact that the one was mated with hens of a resistant strain and the other with hens of the Susceptible one, there can be no doubt of the consistent influence of these 2 sires on the viability of their progeny.

TABLE 2

COMPARISONS OF BODY WEIGHT, EGG WEIGHT, AND EGG PRODUCTION IN THE ORIGINAL POPULATION WITH THAT IN THE 10TH SELECTED GENERATION

Population	Adult body weight (grams)	Adult egg size (grams)	Mean eggs/bird to 500 days of age: Per hen finishing (No.)	Mean eggs/bird to 500 days of age: Per hen starting (No.)
Original unselected (1935)	1,680	54.1	177	90
10th generation (1945)				
C Resistant strain	2,027	59.7	207	186
K Resistant strain	2,102	60.0	186	169
Susceptible strain	1,935	58.5	161	117

(E) *Economic characters*. To satisfy the poultryman, hens must be able not only to withstand disease but also to lay many eggs—eggs that weigh 2 ounces each or more—and to turn in at the end of the productive period a carcass large enough to be desirable for meat. While genetic resistance to lymphomatosis was being established, the two resistant strains were also steadily improved in egg production, size of egg, and body weight.

The full extent of that improvement is best shown by contrasting the performance of the 10th selected generation with that of the original population from which the resistant and susceptible lines were developed (Table 2). The original stock, though unselected with respect to viability, had been bred for high egg production for over 20 years prior to 1935 and was then considered a superior strain.

In spite of that, mean egg production in the C and K Resistant lines to 500 days for hens living to that age was increased in the decade covered in this report by 17 and 5 per cent, respectively. (The averages of 207 for one line and 186 for the other must not be belittled by comparing them with figures often cited by others for average egg production during the *first laying year*, a period that is about 55 days longer than the one used in this study.) However, the mean egg production of birds still alive at 500 days of age can be a misleading measure of value, as it does not consider what proportion of the pullets that started were able to finish. In 1935, that proportion was only 33 per cent of the females alive at 6 weeks of age, but in 1945 it was 78 per cent in one line and 80 per cent in the other.

The better measure, therefore, is the mean egg production of the pullets that were housed in winter quarters at about 160 days (thus disregarding those that died before reaching the age of laying). This figure, sometimes called a "production index," is given in the extreme right column of Table 2 for each group of birds. The indices for the C and K Resistant lines are, respectively, 2.1 and 1.9 times that for the original population. On this basis, the productivity of these strains has been doubled during the decade of selection. In 1942, mean egg production of survivors in the C and K strains was from 10 to 50 eggs per bird higher than for pullets brought in as chicks from four leading breeders of White Leghorns and reared for these comparisons on the local premises (*8*).

Adult body weight and egg weight were recorded annually in March when the birds were about one year old. The former was increased in the decade by 20 and 24 per cent. Egg weight was raised by the 10 or 11 per cent necessary to bring it to the desired level of 58–60 grams, beyond which further increase was unwarranted.

In the Susceptible strain, body size and egg size were improved somewhat, but egg production declined. This was chiefly because high mortality left comparatively few birds for selection as breeders, but also because incipient disease in survivors still alive at 500 days of age lowered the mean production of that group.

General Considerations

In view of (a) the reduction of deaths from lymphomatosis and other neoplasms to 2–7 per cent in the offspring of proven sires and (b) the reduction of mortality from all causes by two-thirds, as well as (c) the improvement in economic characters considered in the previous paragraphs, it would seem that to the original problem one may now write ***quod erat demonstrandum***. Two strains highly resistant to lymphomatosis have been developed. Both are more than satisfactory with respect to egg production, egg size, and body size.

Some say that it has taken too long to accomplish these objectives. The answer is that with the experience of the past decade the same result could now be achieved in less than 10 years. Limiting factors were (a) light exposure of half the chicks up to 1943, which lessened the effectiveness of selection in the first 6 generations, and (b) the difficulty of finding proven sires good enough to use for more than one year. These two limitations retarded progress in the K Resistant strain and completely prevented it in the C Resistant line from 1939 to 1943 (Fig. 2). After they were removed, mortality was quickly lowered in three years.

Uniformly severe exposure was ensured by starting all chicks hatched after 1942 in the brooder house that provided the more severe exposure.

The other limitation—too few proven sires—resulted from the fact that several objectives had to be considered in the selection of breeders. With a single measure of desirability, such as low mortality, half the cockerels tested will prove superior to the average. With any three additional objectives, *e.g.* egg production, body size, and efficient reproduction, half the males are again superior in each, but only about 1 in 16 is superior in all four desiderata. Study of this problem revealed that adequate tests for viability of progeny could be made with families of 30–50 daughters (*12*), these numbers being much less than had previously been considered desirable. This meant that enough daughters for a test could usually be hatched from three weeks' eggs from each breeding pen. Whereas previously each cockerel had sired chicks for the whole hatching season of 10 weeks, a "second shift" and even a "third shift" of cockerels are now used. As a result, 10 pens available for such tests now provide tests of 30 cockerels instead of 10, thus tripling the chance of having superior proven sires to use for two or three years. This has been a big factor in the rapid improvement shown from 1943 to 1945.

Other friendly critics suggest that the C and K Resistant lines differ from the Susceptible one, not in genes, but merely in lacking the causative virus. This, they suggest, is present in the Susceptible line and is regularly transmitted through the egg to each successive generation of that strain. The fact that the virus causing mammary carcinoma in mice can be transmitted in the milk of nursing mothers, or foster mothers, makes plausible the hypothesis of cytoplasmic transmission of the agent, or agents, responsible for lymphomatosis in the fowl. However, such a channel of infection has not yet been demonstrated with respect to avian lymphomatosis. To test the validity of this theory, reciprocal crosses have been made between the C and K Resistant lines and the Susceptible one. The results of these, which will be reported in detail elsewhere, provide no support for the theory, although they do not necessarily disapprove it. They show that the fate of the chick depends as much upon the genes received from the sire as on genes and any cytoplasmic agent transmitted by the dam.

In similar studies, Taylor, *et al.* (*15*) found it easier to lower resistance by selection than to raise it. Some progress was apparently made toward establishing resistance in the first three generations, but this was later lost. From their data it seems possible that insufficient numbers of proven sires may have been a limiting factor, as it was in the Cornell experiments until the "double shifts" and "triple shifts" were introduced. At the Regional Poultry Laboratory, East Lansing, deaths in the 6th selected generation from lymphomatosis alone were already up to 11.4 per cent in their resistant stock by 300 days of age and about twice as high in the susceptible lines (*19*). However, since investigators there are attempting to combine breeding for resistance to lymphomatosis with a program of close inbreeding, it is not surprising that progress has been slow.

UTILIZATION OF RESISTANT STOCK

The object of this experiment was to determine the feasibility of controlling genetically the most serious disease besetting the poultry industry and of improving productivity at the same time. We feel that this has been done. The extent to which poultry breeders not supported by public funds would be justified in undertaking the same sort of work remains to be determined. The desirability of maintaining a susceptible line to ensure exposure may be a deterrent, as such a stock can hardly be profitable. At the same time, more and more breeders and hatcherymen are recognizing that stock sold from flocks not exposed to disease may be the cause of intense dissatisfaction when it is so exposed in the hands of customers. As one of them (*16*) expressed it: "I am convinced . . . that no breeder can afford to have a disease-free farm, or even a relatively disease-free farm." So far as lymphomatosis is concerned, the disease is enzoötic and ubiquitous. Exposure is almost inevitable except in the smaller and more isolated flocks. Experience may show that breeders can develop resistant stock by exposing only enough of their chicks each year to provide tests of sires, while keeping the major part of the birds isolated, in so far as this is possible, and hence comparatively free from disease so that their productivity will not be impaired.

Even without any deliberate exposure to disease, poultrymen can raise the viability of their stock by selective breeding. While this has been demonstrated by Sturkie (*14*), by Bostian and Dearstyne (*2*), and by others, one must be prepared to find such stock highly susceptible to lymphomatosis when conditions are right for its reappearance (*11*).

Another possibility is that resistant strains may be developed at the agricultural colleges and experiment stations and distributed as have been the rust-resistant varieties of wheat and disease-resistant strains of other plants. However, since fowls are dioecious organisms, unless the strains resistant to lymphomatosis are inbred to the stage of almost complete homozygosity (which is unlikely if they are to be economically profitable), continued selection would be necessary to maintain the original resistance.

It may prove more practicable to utilize the resistant strains by sending out their desirable genes in thousands of cockerels to head flocks that supply the hatcheries. Such tests as we have been able to make thus far indicate that cockerels of the resistant stock, when mated with birds unselected for resistance to lymphomatosis, induce a remarkable increase in viability and even in egg production. If these results are substantiated in further tests, it would seem desirable to continue selection, and to have "multipliers" produce sufficiently large numbers of the resistant birds to supply the hatcheries with thousands of males. Since about 90 per cent of the country's chicks are now produced by commercial hatcheries, such a scheme would provide the maximum possible utilization of the genetic resistance that has been established by breeding.

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Toward a National Science Policy?

Study Group, Washington Association of Scientists
Washington, D. C.

After two years in gestation a National Science Foundation Bill emerged from the 80th Congress, only to be vetoed by the President (*Science*, September 12, pp. 236–239). This outcome is undoubtedly puzzling to those who have followed the course of the legislation and are aware of the almost unanimous support for the establishment of a strong national science policy. The paradox exists, however, only when viewed from a distance. Close analysis of the bills introduced into the 79th and 80th Congresses (*Science*, December 27, 1946, pp. 614–619), of the Congressional hearings and debates on these bills, and of the President's veto message and the relevant sections of the recent reports of John R. Steelman (*1*), special assistant to the President, and Attorney General Clark (*2*) shows a sharp cleavage between two opposed philosophies of the relation of science to government and society. From the introduction in the 79th Congress of the original Kilgore and Magnuson Bills, which were based on two sharply divergent conceptions of the nature and purposes of the proposed Foundation, down to the Presidential veto of S. 526, the fundamental dichotomy has persisted and prevented successful completion of the legislation.

In the most general terms, the conflicting philosophies appear to be these. That of the original Kilgore Bill, concurred in by the President and his advisers as well as by many scientists, is based on the premise that science is a national resource, that its raw material is the Nation's scientific manpower, and that, as a vital national resource, its furtherance should be entrusted to an authority directly responsible to the elected representatives of the people—the Congress and the President. The proponents of this philosophy place primary emphasis upon long-range planning for the whole field of science to ensure the development of scientific potential on the widest possible basis throughout the country. They seek guarantees which will deny to special interests a disproportionate influence in formulation of Foundation policy, or disproportionate benefits from its activities. They insist upon a patent policy which will permit free public access to discoveries made with public funds.

The opposing philosophy, embodied in the original Magnuson Bill and, in even more extreme form, in the recently vetoed Smith Bill, regards science as an auxiliary to the development of industry, medicine, and the national defense; it places complete confidence in the existing organizations and facilities for research and believes that these organizations should further the development of science with a minimum of control by the elected representatives of the people. It would thus simply expand scientific activity in the country by enlarging the existing structure, concentrating support in well-tested organizations and centers if results may be thus more effectively attained. It would place control of the Foundation in the hands of recognized leaders in science, industry, and national defense, insulating it from the people's representatives in the interests of security and immediate efficiency.

It is clear that these differences between the two opposed points of view are fundamental and underlie the swirl of controversy which has gone on about more specific issues, e.g. form of administration, inclusion of social sciences, geographic distribution, etc. The basic issue is none other than the proper role of the Federal Government in regulating those areas of our national life which are intimately related to the public welfare and security, in this instance the shape and scope of science. It is not surprising, therefore, to find that groups, organizations, and individuals have lined up on the National Science Foundation very much as they have on atomic energy, national health insurance, Federal support of housing, and similar issues. Science, with its present budget of approximately $1,000,000,000 and a recommended budget (Steelman report) of 1 per cent of the national income, can apparently no longer remain out of the political arena. Issues of fundamental national policy are involved, issues important enough to produce

This analysis of the present status of national science legislation, up to and including the Presidential veto and the subsequent Steelman report, was made by a Study group of the Washington Association of Scientists (a branch of the Federation of American Scientists), consisting of C. Grobstein (chairman), J. M. Conly, I. Feister, L. B. Heilprin, H. Olken, F. J. Pratt, J. W. Rowen, I. Schocken, G. R. Silbiger, R. D. Steiehler, F. J. Weiss, and L. A. Wood. The group had the advantage of being on the spot during consideration of the legislation by Congress, and obtained first-hand information through attendance at committee hearings and floor debate and through interviews and correspondence with interested legislators. Their analysis reveals the basic conflict which has so far prevented the passage of a National Science Foundation Bill.

an impasse between the executive and legislative branches of the Government, as expressed in the recent Presidential veto.

In actual fact, the area of agreement between the contending philosophies is limited to the most general features of the legislation. Nearly all parties concur that some Federal financing of science is required, that the responsible agency should be in civilian hands, and that major emphasis should be given to fundamental or basic research, albeit the exact definition of the latter has remained somewhat hazy. The necessity for increased training of scientific manpower also is generally supported, as well as the importance of coordinating the scientific work of Federal agencies and of encouraging international exchange of scientific information and personnel within the limits of national security.

But beyond these most general features the deep cleavage appears, and the debate becomes bitter. The form of administration of the Foundation has been a major storm center. To many observers this has seemed unfortunate since, it has been said, in the final analysis the success of an organization depends upon its personnel rather than its organization chart. But the opposing schools of thought have sensed in this issue the crux of their entire difference. The Magnuson-Smith school has sought to design the Foundation so as to effect a minimum of change in the existing structure of science. They have tried to erect an administrative barrier between the science agency and the ordinary instruments of Federal authority—a barrier, in other words, which would be permeable to the Federal dollar but impermeable to the virus of Federal control. They have placed final administrative authority in an unsalaried board consisting of scientists and other authorities serving on a part-time basis. In its most extreme form, the original Smith Bill introduced into the Senate of the 80th Congress, this board was to consist of 48 individuals. It was to elect from its own membership an executive committee of 9, which would in turn select a director, the actual administrative head of the Foundation. It was this complex structure which was denounced by the President in his veto message as implying "a distinct lack of faith in democratic processes" and offering the danger that "it would impede rather than promote the Government's efforts to encourage scientific research."

On the other hand, the Kilgore-Administration school believes that science has grown to such stature, and is so important for the national well-being, that its management can be left neither to chance nor in the hands of a small group of private citizens, serving part-time, no matter how well qualified or well intentioned they may be. Moreover, they feel that an activity which is fundamentally geared into the main drive-shafts of our economic and social life cannot be left free from the normal processes of democratic political control. Recognizing the need for protection of the freedoms of the individual investigator from irresponsible political meddling, they nevertheless would firmly integrate the *National Science Foundation* in the Federal governmental structure. Thus, they would place the direction of the Foundation in a single individual, or at most a small, full-time commission, appointed by the President and confirmed by the Senate, and fully responsible to these elected representatives of the people. They would retain the advantages of a larger part-time board by establishing it in a purely advisory capacity.

Thus, the quarrel over administration is essentially one over the nature of the Foundation. The former view would make of it a virtually autonomous agency, Federal only in its financing, quasi-governmental in structure. The latter would make of it a truly Federal agency, integrated in the governmental structure and capable of closely coordinated action with agencies responsible for other aspects of the national life—education, industry, agriculture, defense.

No less sharp has been the cleavage over patent policy. The Magnuson-Smith school seeks to avoid the problem by directing the Foundation to remain within the limits of existing patent policies and practices, executing its contracts "in a manner calculated to protect the public interest and the equities of the individual or organization" (S. 526) involved. The opposing school argues that new problems have been created by the wide-spread support of research by Federal funds, and that existing patent practices and policies are inadequate both to protect free scientific publication and to insure the full exploitation for the benefit of the public of discoveries financed by public funds. They advocate, with certain safeguards, the free availability or the free dedication of all patentable discoveries arising from government-financed research.

Again, in the matter of distribution of funds in support of research, the basic conflict is revealed with the Magnuson-Smith school arguing against any specific directive on the basis of population and geography, on the ground that such mandatory distribution would hamper the Foundation and constitute a "pork-barrel" for all future Congresses. The Kilgore-Administration school argues that the widest possible distribution is required in order to stimulate the growth of science throughout the Nation, and mandatory provision of some kind is the only guarantee against the natural tendency toward centralization of support in already well-established institutions and organizations.

Thus, after nearly three years of debate the issues remain undecided, the contending philosophies unreconciled. It is impossible to predict at this moment what new action may be expected when the 80th Congress reconvenes. The probability of passage of politically disinterested legislation by a Congress in a presidential election year is notoriously low. Meanwhile, new trends are developing, and patterns are being established in the relationship between science and the remainder of society. In spite of almost universal desire for control of science policy by civilians, the absence of a National Science Foundation is establishing control more firmly in military hands. It is widely conceded that we have been weakest in fundamental research, and that strong measures are required to strengthen this aspect of our science. But the present tendency appears to be strongly in the opposite direction, with available funds for research bearing on industrial, military, and health problems enormously overbalancing those available for research having no obvious immediate practical importance. We are in grave danger that our universities will become adjuncts of, and recruiting grounds for, the laboratories devoted to application. Here again goes the goose that lays the golden egg.

As scientists we cannot escape our share of responsibility for the present hazardous state. Congressmen who were interviewed displayed a flattering interest in the views of scientists and their organizations on national science legislation, but many confessed their lack of knowledge of details of the legislation and stated that they had had little advice from home to guide them. One remarked ruefully that, if this were a labor issue, he would have heard from every labor leader in his district. He was forced to conclude that scientists were not very much interested one way or the other.

It must, indeed, be regarded as amazing that individual scientists have made so little effort to influence the legislation, considering the inescapable effect on science and on their personal future that the establishment of a National Science Foundation must have. National scientific organizations banded together in the Inter-Society Committee, and their representatives participated in committee hearings. But when the chips were down and the individual legislators were making up their mind on how to vote, there was very little pressure of the kind that counts—communications from individuals, colleges, institutes, societies, and academies in the *home districts*.

With the formation of the Inter-Society Committee at Boston in December 1946, was there a complacent tendency on the part of individual scientists to overestimate the potential effectiveness of this organization, with a resulting decline in other types of activity? Have we misread the tactical picture assuming the issue to be National Science Foundation, yes or no? The Inter-Society Committee spoke strongly and effectively in favor of the establishment of a National Science Foundation, but was much less clear in its stand on the specific questions which lay at the heart of the controversy and prevented a successful outcome for the bill. Do recent events indicate that the issue is not whether we shall have a Foundation, but, rather, what kind of a Foundation we shall have? What indeed is the proper role of the Federal Government in the support, planning, and direction of science?

As the time for a new Congressional session draws near these are the questions which occupy the minds of observers here in Washington. National science policy will be decided with or without the participation of scientists. But the wisdom of the decisions will in large measure depend upon the forcefulness with which scientists on both sides of the controversy express their considered judgments, both publicly and to their representatives, *now*.

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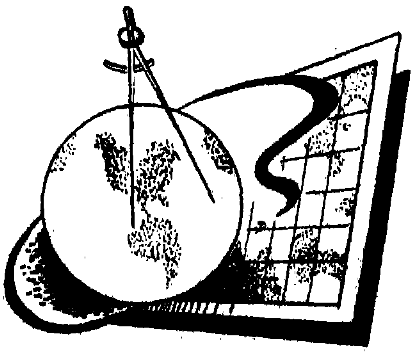

NEWS *and Notes*

Charles J. Vitaliano, formerly with the Non-Metals Section of the U. S. Geological Survey, is now associate professor of field geology at Indiana University. Dr. Vitaliano, who partly replaces **Clyde A. Malott,** who retired on June 30, will develop the new four-year curriculum of training in field geology.

John R. Paul, Yale University School of Medicine, will deliver the Gehrmann Lectures at the Chicago Professional Colleges of the University of Illinois on November 19–20. Dr. Paul will speak on "Poliomyelitis—Certain Epidemiological Aspects" and "Poliomyelitis—The Clinical Disease" at 1:00 P.M. on each day in Room 221, 1853 West Polk Street.

Linus Pauling and **George W. Beadle,** both of California Institute of Technology and both Silliman Lecturers at the centennial celebration of the Sheffield Scientific School, Yale University, received honorary D.Sc. degrees from Charles Seymour, Yale president, on October 17.

Haven Emerson, professor emeritus, School of Public Health, Columbia University, will deliver an address on "Some Factors in Preventing Disease" on October 28 at 4:00 P.M. in the Hunter College Playhouse, 695 Park Avenue, New York City. His address inaugurates the annual Margaret Barclay Wilson Memorial Lecture series, established by the Department of Physiology, Health, and Hygiene, Hunter College, as a tribute to the memory of its first chairman.

William E. Wilson, of the Biology Department, Muskingum College, New Concord, Ohio, has been appointed assistant professor of botany at Miami University, Oxford, Ohio.

Harry J. Fuller, professor of botany, University of Illinois, spent a part of the summer in Peru and Bolivia, collecting and photographing the plants of those two regions.

W. E. Caldwell and **J. P. Mehlig** have been promoted to the rank of professor, **Ralph W. Spitzer** to associate professor, and **Allen B. Scott** to assistant professor in the Chemistry Department of Oregon State College, Corvallis.

George Polya, professor of mathematics, Stanford University, and **Hermann Weyl,** Institute for Advanced Study, Princeton, New Jersey, have been elected foreign members of the French Academy of Sciences. The only other living American mathematician to have received this distinction is **L. E. Dickson,** professor emeritus, University of Chicago.

Donald S. Farner, formerly of the University of Wisconsin, has been appointed associate professor of physiology, State College of Washington, Pullman, where he will have charge of instruction in physiology in the College of Sciences and Arts.

John Emsley Funnel, research ceramist, Products Development Department, Corning Glass Works, has been appointed ceramic engineer and economic geologist, Midwest Research Institute, Kansas City, Missouri.

Catherine Personius, chairman, Department of Food and Nutrition, College of Home Economics, Cornell University, has been appointed assistant director, Cornell University Agricultural Experiment Station.

R. C. Gutschick, formerly geologist, Gulf Oil Corporation, Oklahoma City, has been appointed assistant professor of geology, Division of Geology, University of Notre Dame.

Paul M. Gross, head, Department of Chemistry, and chairman, Research Council, Duke University, has been appointed dean of the Graduate School, succeeding **Calvin B. Hoover,** who will continue as chairman, Department of Economics.

William E. Feist, formerly development engineer, Cambridge Instrument Company, Inc., Ossining, New York, has been appointed assistant professor of electrical engineering, University of Missouri, School of Mines and Metallurgy, Department of Electrical Engineering, Rolla, Missouri.

Hermann J. Muller, professor of zoology, Indiana University, lectured on the topic, "The Production and Avoidance of Mutations," at a dinner given in his honor by the Purdue Chapters of the American Society of Plant Physiologists, Society of the Sigma Xi, and the Purdue Biological Society, October 20, 1947.

Visitors to U.S.

R. C. Evans, Crystallographic Laboratory, University of Cambridge, England, will visit this country at the invitation of the American Society for X-Ray and Electron Diffraction to see recent American developments in the field of crystallographic equipment. Dr. Evans is technical editor of the new publication, *Acta Crystallographica.*

J. N. Van Niekerk, National Physical Laboratory, Council for Scientific and Industrial Research, South Africa, is now visiting the United States and expects to remain here until January 1948.

F. R. N. Nabarro, University of Bristol, is coming to the United States to inspect metallurgical work in this country. Dr. Nabarro, whose visit is sponsored by the Royal Society and the British Iron and Steel Research Association, plans to remain here about three months.

W. J. Lutjeharms, professor of botany, University College of the Orange Free State, arrived in this country in August on a grant from the South African Council for Scientific and Industrial Research.

A. C. Riddle, physical chemist, Building Research Station, Department of Scientific and Industrial Research, England, is now in the United States doing chemical liaison work for the United Kingdom Scientific Mission.

F. X. Laubscher, senior research officer, Department of Agriculture, South Africa, and in charge of plant breeding work, College of Agriculture, Potchefstroom, is in this country to investigate fiber production and to visit experiment stations where corn-breeding is being done. Mr. Laubscher leaves for New Zealand and Australia at the end of this month.

Werner Nowacki, University of Berne, Switzerland, who lectured on "The Distribution of Crystal Structures Among the Space Groups, and the Symmetry

Principles of Organic Crystals," September 22 at Alabama Polytechnic Institute, is now returning to Switzerland after visiting many American laboratories and working for 6 months with the crystal analysis group, under the direction of Linus Pauling, at the California Institute of Technology.

Grants and Awards

The Laurentian Hormone Conference on September 12 conferred the Roche-Organon Awards on Fuller Albright, of Boston, Dwight J. Ingle, of Kalamazoo, and R. D. H. Heard, of Montreal. The Awards were of $500 each, instead of the amounts erroneously announced in *Science*, September 5.

National Dog Week, Inc., 424 Madison Avenue, New York City, is now considering candidates for the $2,000 National Dog Week research award, which will be presented early in 1948. The award will be given for the most outstanding contribution to the welfare of dogs during the year 1947. Candidates may submit their reports to the National Dog Week or be nominated by a friend. The jury on awards is made up of C. A. Elvehjem, dean, Graduate School, University of Wisconsin; A. C. Ivy, vice-president, Chicago Professional Colleges, University of Illinois; W. A. Young, Anti-Cruelty Society, Chicago; James H. Steele, chief, Veterinary Public Health Section, U. S. Public Health Service, Washington, D. C.; and Carl F. Schlotthauer, Mayo Foundation, Rochester, Minnesota.

Warren A. Marrison, of the technical staff, Bell Telephone Laboratories, has been awarded the British Horological Institute's Gold Medal for 1947 in recognition of pioneer researches in the development of the quartz crystal clock. The medal will be presented by Sir Harold Spencer Jones, Astronomer Royal and president, British Horological Institute, at its 89th annual general meeting in London, October 29. On November 6, Mr. Marrison will lecture before the Institute on "The Evolution of the Quartz Crystal Clock." The quartz crystal clock, as now developed, has become the world's most accurate timekeeper. Its rate is regulated by a control unit made from quartz crystal, the stability of which exceeds that of all other control devices previously used. A clock of this type, located at Bell Telephone Laboratories headquarters, New York City, is accurate to well within a second a year.

The American Pharmaceutical Manufacturers' Association will present its 1947 scientific award to the American Medical Association at its midyear meeting to be held December 15–17 in New York City. This award is made annually, on nomination by a scientific advisory committee, for a fundamental research contribution to public health in the field of drug therapy. Previous recipients have been the Mayo Foundation for Medical Research (1946); the Rockefeller Institute for Medical Research (1945); the National Research Council (1944); and Alexander Fleming and Howard W. Florey (1943).

Colleges and Universities

Iowa State College has recently awarded 6 Master of Science degrees in agricultural climatology, a new course which has been worked out as a cooperative venture between the College and the U. S. Weather Bureau. Plans for the course, leading to M.S. and Ph.D. degrees in agricultural climatology, were initiated in the fall of 1944 by H. C. S. Thom, U. S. Weather Bureau, in cooperation with R. E. Buchanan, dean, Graduate School, and director, Iowa Agricultural Experiment Station, and W. H. Pierre, chairman, Section in Agronomy, Agricultural Experiment Station. Five of the graduating students were assigned to positions in the Weather Bureau, while the sixth will return to Brazil to resume teaching in the Minas Gerais State College of Agriculture.

The Ohio State University has recently created the Julius F. Stone Research Professorship in Physics in memory of the late Julius F. Stone, chairman emeritus, Board of Trustees, for more than 20 years until his death, July 25, 1947. The new professorship, which has not yet been filled, will have special reference to nuclear physics, the fundamental relationships between matter and energy, and the biological and medical applications of radiations.

The Department of Psychology, University of New Mexico, has three recent additions to its staff. **James C. Coleman**, University of Kansas, and **Morton J. Keston**, University of Minnesota, have been appointed assistant professors; and **David T. Benedetti**, graduate assistant, University of New Mexico, has been named instructor.

The University of Tennessee has added the following new members to its Department of Botany: **Russell B. Stevens**, Alabama Polytechnic Institute; **J. Herbert Taylor**, University of Oklahoma; **Lowell F. Bailey**, TVA Forestry Laboratory; **Shirley Hoover Taylor**, University of Oklahoma; **Frederick H. Norris**, Ohio State University; and **Kenneth A. Wagner**, University of Michigan.

The University of Minnesota has made several recent changes in the staff of its Department of Botany. **A. Orville Dahl** has been named chairman of the Department succeeding **Ernst C. Abbe**, who has completed his three-year term in that office, and who will continue as professor of botany. **Donald B. Lawrence** has been promoted from assistant to associate professor and **R. M. Tryon, Jr.**, from lecturer to assistant professor and curator of the Herbarium. **Allan H. Brown**, University of Chicago, **Harlan P. Banks**, Acadia University, and **Albert W. Frenkel**, University of Rochester, have been appointed assistant professors, and **Gerald B. Ownbey**, Missouri Botanical Gardens, instructor.

The University of Oregon has recently made several faculty appointments and promotions. In the Department of Anthropology, **Daniel S. Davidson**, formerly of the University of Pennsylvania, has been appointed associate professor and assistant curator of Anthropology, and **Robert F. Spencer**, Reed College, has been appointed assistant professor. **Eugene P. Cooper**, formerly research physicist, Naval Ordnance Test Station, Inyokern, and **Frederick W. Paul**, Institute of Optics, University of Rochester, have joined the Department of Physics as associate professors. **Clarence W. Clancy** has been promoted to associate professor, and **I. M. Newell** to assistant professor, in the Department of Biology.

The Department of Biology, University of Colorado, has added **Edwin R. Helwig**, Department of Zoology, University of Pennsylvania, and **T. Paul Maslin**, formerly of Colorado State A. & M. College, as assistant professors.

Santa Barbara College, University of California, has made several recent changes in its Department of Biological Sciences. **Mary M. Erickson**, assistant professor of biology, has been promoted to associate professor of zoology, and **James L. Walters** and **Roscoe C. Main** have been appointed instructors in botany and zoology, respectively.

The University of Texas has made the following appointments in its Department of Chemistry: **L. O. Morgan,** formerly with the Manhattan Project at the Universities of Chicago and California and co-discoverer of the element Americium, has been appointed assistant professor; **Royston M. Roberts,** recently of the University of California at Los Angeles, has been appointed assistant professor; and **Frank Field,** Duke University, has been appointed instructor.

At the College of Medicine, University of Nebraska, there have been a number of faculty changes. **Harold E. Eggers,** chairman, Department of Pathology and Bacteriology, has retired; **J. P. Tollman** has been appointed professor of clinical pathology and chairman, Department of Clinical Pathology and Bacteriology; **John R. Schenken,** formerly head, Department of Pathology, Louisiana State University, and pathologist, Nebraska Methodist Hospital, Omaha, has been appointed professor of pathology and acting chairman, Department of Gross and Microscopic Pathology; **Pliney Allen,** formerly associated with Louisiana State University and Pratt Diagnostic Hospital, Boston, has been appointed assistant professor of pathology, and pathologist, Immanuel Hospital, Omaha; and **Robert M. Allen,** University of Minnesota, has been appointed assistant professor of bacteriology.

Meetings

The Fifth Annual Pittsburgh Conference on X-Ray and Electron Diffraction, sponsored by the Mellon Institute and the University of Pittsburgh, will be held November 7–8 at the Mellon Institute, Pittsburgh, Pennsylvania. The first session, beginning at 9:40 A.M. Friday, will be a symposium on "Interstitial Compounds and General Papers." At 2:00 P.M. Friday, the subject of the session will be "X-Ray and Electron Diffraction Studies at High Temperatures." A dinner will be held at the Faculty Club, University of Pittsburgh, on Friday evening, after which Sterling B. Hendricks, principal chemist, U. S. Department of Agriculture, will speak on "Crystal Structure and Lattice Termination in Clays and Related Products" at the Mellon Institute Auditorium. The Saturday morning session will be a symposium on "Lattice Imperfections and General Papers." Saturday afternoon's symposium will be on the topic, "Geiger-Counter X-Ray Spectrometer Studies."

The Alabama Polytechnic Institute, in cooperation with the Oak Ridge Institute of Nuclear Studies, will hold a three-day conference on "The Use of Radioactive Isotopes in Agricultural Research" on December 18–20, at Auburn, Alabama. The program will include: "Techniques of Tagged Atom Research," W. A. Arnold, Clinton Laboratories, Oak Ridge; "Radioactivity and Radioisotopes," Fred Allison, Alabama Polytechnic Institute; "Isotopes Available for Research," Paul C. Aebersold, AEC, Oak Ridge; "The Measurements of Radiations by Various Methods," Paul W. McDaniel, AEC, Washington, D. C.; "Protective Precautions in the Handling of Radioactive Materials," G. William Morgan, AEC, Oak Ridge; "Contributions of the Atomic Energy Commission to Agricultural Research," John C. Franklin, AEC, Oak Ridge; "Agricultural Research With Radiophosphorus," S. B. Hendricks, Bureau of Plant Industry, Beltsville, Maryland; "Studies of Chlorosis Using Radioactive Phosphorus and Iron," Orlin Biddulph, State College of Washington; "Agricultural Research With Radioactive Sulfur and Arsenic," M. D. Thomas, American Smelting and Refining Company, Salt Lake City; Demonstration of a typical tracer experiment, Wendell C. Peacock, Clinton Laboratories, Oak Ridge; "Atomic Energy Radiations and Plant Nutations," S. J. Sadler, University of Missouri; "Use of C^{14} for Tracer Research," Howard B. Skipper, Southern Research Institute, Birmingham, Alabama; "Nutrition Studies With Radiocobalt," J. G. Davis, University of Florida; and topics to be selected, by G. Harold Copp, University of California. The attendance, through special invitations, will consist of representatives largely from the southeastern states.

The American Association of Physics Teachers will hold its 17th annual meeting December 29–31 at the University of Chicago in cooperation with the AAAS and the American Physical Society. The 7th Richtmyer Memorial Lecture will be given at the meeting, and the Oersted medal will be presented. Those desiring to present papers must submit titles and abstracts, typewritten double spaced and in triplicate, by November 10 to the program chairman, J. W. Buchta, Department of Physics, University of Minnesota, Minneapolis 14, Minnesota. Programs of this meeting will be mailed to all Association members soon after November 10. Members who have business for the Executive Committee, which will meet in December, should present it in writing to the secretary, C. J. Overbeck, Northwestern University, before December 1.

The American Mathematical Society held its 53rd summer meeting at Yale University September 2–5, in conjunction with meetings of the Mathematical Association of America and the Institute of Mathematical Statistics. T. R. Hollcroft, associate secretary, reports that over 700 persons attended, including 443 members of the Society. Oscar Zariski, Harvard University, delivered the four Colloquium Lectures on "Abstract Algebraic Geometry," and S. S. Wilks, Princeton University, gave an address entitled "Sampling Theory of Order Statistics." A total of 149 research papers were presented, 73 in person and 76 by title. At the meeting of the Council of the Society, Tuesday evening, and also at a business meeting of the Society, it was announced that the late Mrs. John Irwin Hutchinson had made a bequest of $1,000 to the Society in memory of her husband, professor of mathematics at Cornell University who had been associated with the University from 1894 until 1935, one of the first cooperating editors of the *Transactions* of the Society, and vice-president in 1910.

The Rocky Mountain Laboratory, Hamilton, Montana, was host to the International Great Plains Conference of Entomologists, August 11–13, and to the International Northwestern Conference on Diseases of Nature Communicable to Man, August 13–16. Participants present were from 13 states and the District of Columbia, four Canadian provinces, Spain, Holland, India, and Mexico. The programs included tours of the Laboratory, visits to Montana State University, and lectures and discussions of interest to those in attendance.

NRC News

"Personnel and Training Problems Created by the Recent Growth of Applied Statistics in the United States" is the title of a report recently prepared by the Committee on Applied Mathematical Statistics of the NRC. Chairman of the group is Luther P. Eisenhart, former chairman, Division of Physical Sciences, NRC, and the secretary is Samuel S. Wilks, professor of mathematical statistics, Princeton University. Other members include: Chester I. Bliss, Connecticut Agricultural Experiment Station; Edward U. Condon, National Bureau of Standards; Harold O. Gulliksen, Princeton University; Lowell J. Reed, Johns Hopkins University; Charles F. Roos, The Econometric Institute, Inc.; Walter A. Shewhart, Bell Telephone Laboratories; Hugh M. Smallwood, U. S. Rubber Company; and Frederick F. Stephen, Cornell University.

As a simple indication of growth of interest in statistical methods, the Committee describes the formation and recent growth of statistical organizations. The American Statistical Association, founded more than 100 years ago had a membership of 1,700 in 1935. By the end of 1946 it had nearly 4,000 members. The Institute of Mathematical Statistics, formed in 1935 to promote the development of statistical theory, had 900 members by the end of 1946. The Econometric Society, with a membership of more than 750, was organized in 1930 to promote the application of mathematics and statistical methods in economics. The Psychometric Society, a similar organization for psychology, was organized in 1935 and now has more than 200 members. The Biometrics Section of the American Statistical Association, formed in 1938 for sponsoring similar work in the biological sciences, now has more than 1,100 members. The most recent statistical organization is the American Society for Quality Control, which is concerned with applications of statistical methods in industry. Organized early in 1946, it now has approximately 2,000 members, mostly engineers. There are other organizations with considerable interest in statistical methods such as the American Marketing Association, American Public Health Association, American Sociological Society, and Population Association of America.

According to the report, there is a heavy demand for both academic and nonacademic statistical personnel. Nonacademic fields which account for most of the recent growth of interest in statistical methods are: (1) industrial statistical control (in quality control, research, and development), (2) research in the biological sciences, (3) collection and analyses of government statistics, (4) market research and commercial surveys, and (5) psychological testing. Each is discussed in some detail. Demands are continuing and increasing for statistical personnel in some of the older fields such as finances and taxes, labor and employment, prices and production. Demands for more statistical training for social scientists are increasing.

The Committee made an inquiry among 30 leading authorities at 27 universities in mathematical and applied statistics as to requests received for statistical personnel for a period of approximately 6 months after the end of the war. These authorities reported a total of 135 requests for personnel for academic positions in mathematical and applied statistics ranging from instructorships to full professorships. No attempt was made to have each respondent identify each request so as to eliminate duplication. But one person reported that he had received requests from 21 college and university mathematics departments for Ph.D.'s in mathematical statistics. Another reported 12 requests for Ph.D.'s in agronomy with minors in statistics. Ninety requests from government agencies and 140 from industry were reported. The training requirements for these requests ranged from B.A.'s to Ph.D.'s in mathematical and applied statistics.

At least a rough comparison may be made between demands for personnel in mathematics, physics, and statistics. As of December 31, 1945, the National Roster of Scientific and Specialized Personnel had registrations of 9,972, 9,608, and 2,018 in mathematics, physics, and statistics, respectively. From September 1, 1945, to May 31, 1946, the numbers of requests for personnel in these three fields per 1,000 persons registered were 4.4, 23.9, and 30.7, respectively.

More than a third of the report is devoted to problems of education and training in statistics, which were discussed at both the undergraduate and the graduate level. It was stated that although substantial progress had been made in the teaching of statistics at the graduate level in a number of universities, it was still inadequate to meet the growing demands for statistical personnel. The Committee charged that the teaching of statistics at the undergraduate level was still in a very chaotic condition. Graduate teaching in mathematical statistics is more standardized than that in applied statistics. Basic requirements in mathematics for graduate training in mathematical statistics were listed as follows: real and complex variables, linear and quadratic forms, matrix algebra, n-dimensional Euclidean geometry, measure and integration theory. The courses are essential for the theory of probability which is the foundation for courses in advanced mathematical statistics covering distribution theory, estimation theory, testing of statistical hypotheses, and multivariate statistical theory.

Of the 27 universities included in the inquiry, only 10 claimed a graduate program leading to a Ph.D. degree in mathematical statistics, and 14 an adequate training program at the advanced level for some field of applied statistics. Only 4 of the universities have special stipends for graduate work in mathematical statistics. The situation in applied statistics is hardly any more adequate.

The Committee emphasized the duplication of material in elementary statistics courses as they are now taught in various departments of a given college or university, as well as the heterogeneity of the quality of teaching. The opinion was expressed that the standardization and improvement of the teaching of statistics at the undergraduate level is a basic requirement for the solution to the problem of training statistical personnel. Specifically, it proposes that there should be developed a basic course in statistics at the freshman level for students who will go into the natural and social sciences, standardized to the same extent as introductory courses in mathematics, physics, and chemistry.

According to the Committee, one of the most puzzling problems regarding statistics is how it should be organized within a university. Two plans being tried out at certain universities were discussed: (1) the statistical laboratory and research center which would serve as an informal campus statistical center, and (2) the department of statistics. Plan (1) is necessarily rather informal and depends for its success on the voluntary cooperation of personnel from various departments who are interested in research and teaching of statistics. Plan (2) would be more formal and desirable, but its success would depend on joint membership of its personnel with other departments. This is particularly important for the effective teaching of applied statistics, which should be carried out in conjunction with departments interested in applications of statistical methods.

The Committee summarized its conclusions as follows:

(1) There should be developed a basic introductory course in statistics at, preferably, the freshman level for colleges and universities throughout the country.

(2) The laboratory work in the average course in statistics is inadequate, particularly at the elementary level; experimental work should replace much of the computation at this level.

(3) The minimum requirement in effective organization is a central statistical laboratory with which all of those teaching or doing research in statistics would be associated, even though informally in some cases.

(4) More success is to be expected from a department of statistics associated with a statistical laboratory, and having some members in common with other departments.

(5) The number of institutions needed for giving first-class training through the graduate level are: (a) 5–10 in mathematical statistics, (b) 25–30 in varying fields of applied statistics.

(6) An institution giving complete training in either mathematical or applied statistics should give some training in the other.

(7) Institutional stipends for graduate students specializing in mathematical and applied statistics are inadequate.

(8) In strengthening its statistical work at the advanced and research levels, any given university should consider which field it can develop most effectively, so as to avoid duplication and inefficiency from a national point of view.

(9) The immediate critical shortage of highly qualified teachers can be eased only by suitable training of high-grade personnel now in fields of application, or mathematics.

(10) An adequate number of postdoctoral fellowships in statistics is needed.

(11) Arrangements should be established whereby postgraduate students, research workers, and teachers on leave would be able to obtain work experience in certain government agencies, industrial laboratories, and business research organizations.

(12) To help offset the present critical shortage of qualified personnel in applied statistics, it would be desirable to promote conferences at advanced levels and short courses at the elementary level in various fields.

Recent Deaths

Ole A. Nelson, 55, Battelle Memorial Institute staff member in charge of research activities on metals and chemicals in agriculture, died September 17 following an extended illness.

José F. Nonidez, 55, professor of microscopic anatomy, University of Georgia Medical School, and formerly professor of anatomy, Cornell University Medical College, died in Augusta, Georgia, September 27, after a brief illness.

Frederic Lendall Bishop, 71, professor of physics, University of Pittsburgh, since 1909, died October 10 at his home in Fox Chapel Manor, Pennsylvania.

Ellsworth Huntington, 71, research associate in geography at Yale University until his retirement in 1945, died October 17 at his home in Hamden, Connecticut. Dr. Huntington had been a member of the Yale faculty since 1907.

The American Institute of Physics, 57 East 55th Street, New York City, plans to publish a new monthly journal in physics which will be designed to fill part of the gap now existing between technical journals and popular science magazines. **David A. Katcher,** Naval Ordnance Laboratory, Washington, D. C., has been appointed editor of the as yet unnamed magazine, which will make its appearance early in 1948.

The Loyal Order of Moose has appointed a National Advisory Council for Research in Gerontology for the Fraternity's city for the aged at Moosehaven, Florida, near Jacksonville. The members of the Council include: Allan G. Brodie, dean, University of Illinois College of Dentistry, Chicago; Anton J. Carlson, emeritus professor, Department of Physiology, University of Chicago; Louis J. Haas, director, Men's Therapeutic Occupations, New York Hospital, White Plains; George Lawton, consulting psychologist, New York City; S. L. Pressey, president, Division on Maturity and Old Age, American Psychological Association, Ohio State University; Martin L. Reymert, director, The Mooseheart Laboratory for Child Research; and N. W. Shock, chief, Gerontology Section, Baltimore City Hospitals.

The well-known Mooseheart Laboratory for Child Research, in Illinois, established by the same organization 17 years ago, has provided facilities for research in human development which have been utilized widely, and it is hoped that a similar arrangement may be made with respect to the new development. Inquiries may be addressed to Dr. Reymert.

The South African Association for the Advancement of Science is now publishing and editing *South African Science*, a monthly bulletin devoted to affairs of the Association, preliminary announcements of new discoveries, short communications, book reviews, longer articles, and so on, which will appear in English or Afrikaans, depending on the language in which they are received. The bulletin, the first issue of which appeared in August, is free to members of the Association; others may subscribe at 15/– per year. Further information with respect to contributions and subscriptions may be obtained from The Editors, *South African Science*, P. O. Box 6894, Johannesburg.

Make Plans for—

American Institute of Electrical Engineers, Midwest General Meeting, November 3–7, Chicago, Illinois.

American Institute of Chemical Engineers, November 9–11, Detroit, Michigan.

National Committee for Mental Hygiene, November 12–13, Hotel Pennsylvania, New York.

American Society of Animal Production, November 28–29, Chicago.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Elementary Effect of Arginase in the Weight Physiology of the Mouse

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A series of experiments dealing with the effect of *arginine* and its enzyme, *arginase*, upon growth and repair in the mouse has been the subject of a preliminary report (*1*). It was noted that administration of arginase intraperitoneally resulted in a systemic effect observable in a corresponding weight curve. Further substantiation of this phenomena has been obtained and will be the subject of this report.

Two series of animals have been used. Results from the first, 20 white mice of the Hamilton strain, with 20 controls, were obtained in January 1946. These were normal, hardy white mice. Results from the second series, 20 C3H strain with the same number of controls, were obtained in March 1947. This strain of mice was bred to develop tumors. The procedure upon both groups was identical, with the exception that the arginase used on the first series was obtained from the Biochemistry Laboratories of the University of California, and that used on the second series was prepared in our own laboratories. The same unit dosage was used in both instances.

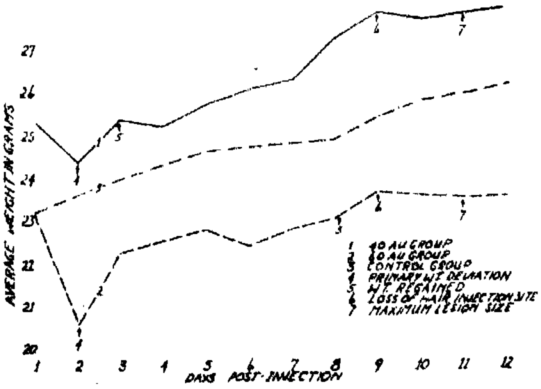

FIG. 1. Hamilton strain.

In the first and second series the animals were divided into groups of 10. One group received 40 AU (arginase units) (*2*) and a second group, 60 AU. Each animal was weighed prior to injection and at the same hour daily thereafter. (Minor exceptions are indicated in Figs. 1 and 2.) The injections were given intraperitoneally in the lower abdominal region.

Although a year elapsed between the two series, similar corresponding curves were obtained; and, in all animals injected, a lesion developed at the sight of injection upon the 8th day.

The weight charts indicate weight in grams and days post-injection of Series I and II, respectively. It will be observed that in the two groups of the first and the second series receiving 40 AU there was a weight deviation in the first 24-hour period of 0.9 gram and 0.8 gram, their injection-day weight being regained between the 3rd and 4th day. The two groups receiving 60 AU showed a weight deviation in the first 24-hour period of 2.6 grams and 2.0 grams, respectively. These did not regain their injection-day weight until late in the 7th or early in the 8th day. The lesion mentioned above developed in all of the injected groups on the 8th day. In the first series, both the 40 AU and the 60 AU groups manifested the lesion by a loss of hair around the injection site, followed in a progressive manner by a complete autolysis of the skin, abdominal musculature, and fascia to (but not including) the peritoneum, reaching this point upon the 11th day post-injection. In the second series, the 40 AU group showed a loss of hair, but further autolysis did not occur. The 60 AU group of this series, however, did develop the complete lesion as described.

The loss of hair on the 8th day is the first indication of any physiological reaction other than the weight change. The denuded surface shows no evidence of an inflammatory process. In the animals that experienced autolysis, the lesion maintained a sterile appearance during its entire progress.

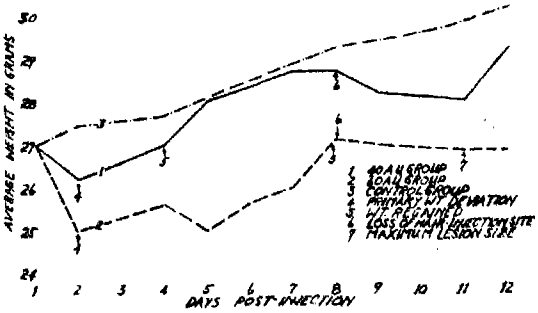

FIG. 2. C3H strain.

No rubor, suppuration, exudate, or swelling was in evidence. Regeneration appeared at the periphery, and the area covered over with a resultant permanent scar and loss of hair. The weight then tended toward normal.

The following conclusions may be drawn:

(1) The AU dosage is proportional to the time necessary for the animal to regain its injection-day weight.

(2) The differential in the primary weight loss of each of the two dosage-related groups indicates that there is a greater ratio of free arginine in the C3H tumor-producing strain.

(3) The greater arginine ratio in the C3H strain requires a slightly higher amount of arginase than the 40 AU used to produce the complete lesion.

(4) Re-establishment of the preinjection arginine-arginase balance in the intercellular fluid begins at the periphery of the lesion where the greatest dilution of the enzyme occurs. While

the injection was made intraperitoneally, the lesion results from an amount of the enzyme spreading about the trauma produced by the insertion and removal of the needle.

(5) The introduction of a suitable amount of arginase into the system buffers the arginine of the body, and, when into the tissues directly, inhibits the action of this substance in normal cell metabolism.

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Antibiotic Compound Isolated From the Lichen *Ramalina reticulata*[*]

A. Marshak, G. T. Barry,[1] and L. C. Craig

Tuberculosis Control Division, U. S. Public Health Service, and *The Rockefeller Institute for Medical Research, New York City*

Experiments conducted during the period July 1945–January 1947 showed that a crystalline substance isolated from *Ramalina reticulata* had *in vitro* antibiotic activity against a variety of gram-positive organisms and some acid-fast bacteria, including *Mycobacterium tuberculosis hominis*, but not against a number of different gram-negative organisms tested. *In vivo* tests with mice infected with pneumococcus gave negative results, while similar tests with tuberculous guinea pigs showed significant retardation of the progress of the disease (*6*).

Addition of base did not yield simple solutions of the lichen acid, and on the basis of this observation V. C. Barry suggested that the compound isolated might be usnic acid (*1*), shown to be a common constituent of many lichens.

The comparative studies described below were made with a sample of usnic acid received from V. C. Barry and isolated from *Cladonia sylvatica* [L] Harm. emend. Sandst.

The empirical formula (*5*) for usnic acid is given as $C_{18}H_{16}O_7$ [C: 62.79, H: 4.65]. The compound isolated from *Ramalina reticulata* gave the analytical figures [C: 62.88, H: 4.61], as previously reported, in excellent agreement with the above empirical formula. As doubt existed concerning the purity of the parent compound, an attempt was made to prepare a methoxyl derivative with diazomethane. It did not crystallise, but upon distillation in a molecular still gave analytical data [C: 65.75, H: 5.26, OCH_3: 9.50] which fitted the empirical formula $C_{16}H_{14}O_6$ (*6*). However, as the fractionally distilled methoxyl derivative was not crystalline, its homogeneity was also questionable.

A study was made of the homogeneity of the parent compound isolated from *Ramalina reticulata* by the method of countercurrent distribution (*4*). Sixty mg. of the material was distributed in a 24-tube countercurrent distribution machine, using a system containing 20 per cent cyclohexane and 80 per cent benzene as the upper layer and 10 per cent water and 90 per cent methanol as the lower layer, the two phases having first been equilibrated with each other before being used for the distribution. The volumes of the two phases were 12 cc. (upper phase) and 8 cc. (lower phase), giving an operational distribution ratio, K, of 0.41. In Fig. 1 is shown a 24-transfer distribution pattern of the substance. The concentration in each tube was determined by absorption at 284 mμ using the Beckman spectrophotometer. From the nearly complete correspondence with the theoretical curve it can be concluded that the material is apparently homogeneous, and therefore the empirical formula can safely be derived on the basis of the analysis of the original compound isolated rather than the doubtful methoxyl derivative.

The molecular weight of the compound as determined from the methoxyl content in the methoxyl derivative and by an alkali acetone titration of the parent compound was about 310.

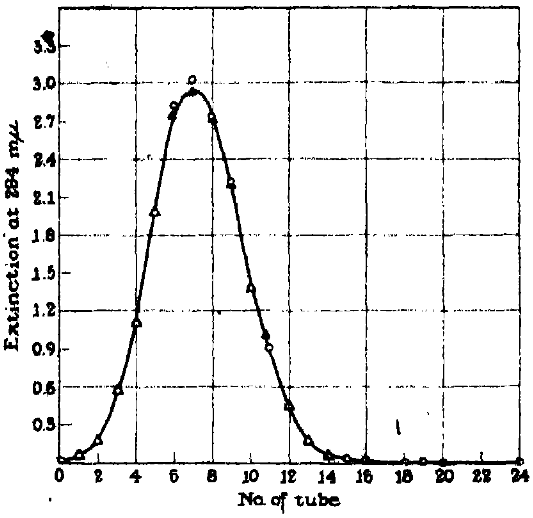

Fig. 1

This value favors a compound with an empirical formula $C_{16}H_{14}O_6$ (M., 302) rather than $C_{18}H_{16}O_7$ (M., 344) (*6*). However, since the acetone titration method employed can be considered valid only to within 5–10 per cent, the value 344 could still be considered possible as the molecular weight for the compound isolated from *Ramalina reticulata*. The coincidental similarity of the molecular weights as determined by the two methods first led the authors to consider the lower empirical formula. The later homogeneity study performed on the parent compound and the additional evidence given below now favors $C_{18}H_{16}O_7$ as the more probable value.

Usnic acid has been reported to melt in the range of 191–205° (*3, 7*). The compound isolated from *Ramalina reticulata* was reported to melt at 193–194° and showed a melting point similar to the compound received from V. C. Barry and isolated from *Cladonia sylvatica*. The melting point of the mixture of the two compounds showed no depression.

The ultraviolet absorption spectrum of the compound from *Ramalina reticulata* (Fig. 2) was similar to that of the compound isolated from *Cladonia sylvatica*. The absorption maxima are at 226–230 mμ and at 284 mμ.

The optical rotation for the compound from *Ramalina reticulata* in chloroform was $[\alpha]_D^{25} = +498°$, which corresponds to the value +495° reported for d-usnic acid (*4, 5*). The compound isolated from *Cladonia sylvatica* gave an $[\alpha]_D^{25} = -20.8°$ in chloroform and was considered to be the racemate of usnic acid with a small admixture of the l-form (*2*).

A study of the adsorption spectrum in the infrared region was made by Konrad Dobriner, of Memorial Hospital, New

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[1] Fellow of the National Institute of Health and visiting investigator at the Rockefeller Institute for Medical Research.

York City, and at the American Cyanamid Company. Both substances showed absorption bands similar in frequency and shape at 40 points. The correspondence of these two compounds at so many frequencies would leave little doubt as to their identity.

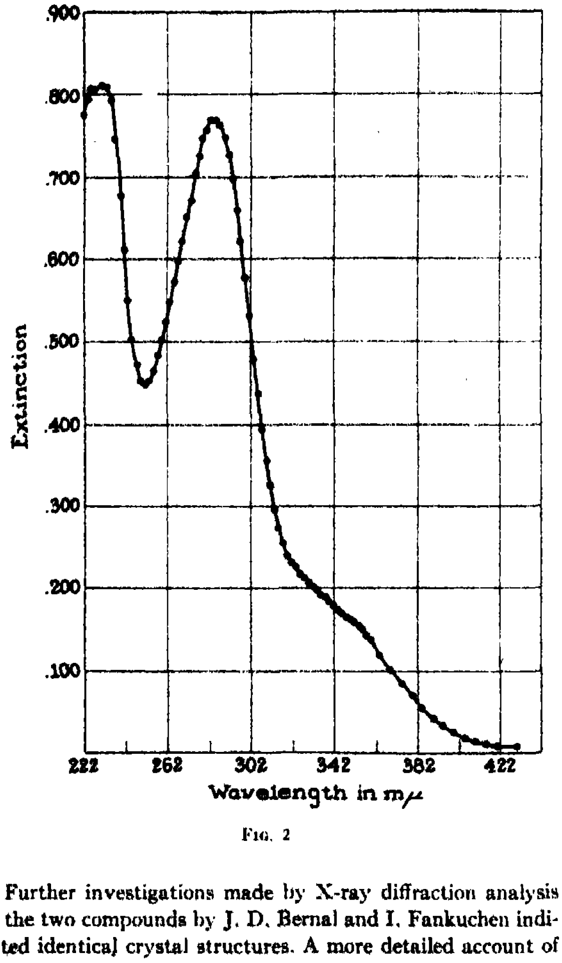

FIG. 2

Further investigations made by X-ray diffraction analysis of the two compounds by J. D. Bernal and I. Fankuchen indicated identical crystal structures. A more detailed account of their studies will be published elsewhere.

The results previously published (*6*) on *in vitro* inhibition of growth of various bacteria by the compound from *Ramalina reticulata* agree in general with those of Stoll and co-workers (*7*). Inhibition of gram-negative organisms is not obtained except at relatively high concentrations, while gram-positive organisms are inhibited by low concentrations. Human and bovine tubercle bacilli are inhibited by low concentrations, but the concentration required for inhibition of the avian strains of tubercle bacilli is higher.

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Relative Growth Rates of Bean and Oat Plants Containing Known Amounts of a Labeled Plant-Growth Regulator (2-Iodo^{131}-3-Nitrobenzoic Acid)

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Succulent dicotyledonous plants are generally more sensitive to growth-regulating substances than are most plants of the monocotyledonous type (*2*), yet very little is known regarding the factors responsible for this difference in sensitivity. In recent experiments with the growth-regulating substance 2-iodo^{131}-3-nitrobenzoic acid (INBA) labeled with radioiodine, bean plants were found to absorb and translocate this compound more readily than barley plants (*3*), and a new tool was provided for observing still other differences in the way some dicotyledonous and monocotyledonous plants respond to growth regulators of this type.[1]

The present experiments were undertaken to determine, in part, whether the difference in sensitivity of plants, such as bean and oat, to such a growth regulator as INBA can be accounted for on the basis of a quantitative difference in their ability to absorb and translocate the compound. By applying radioactive INBA in varying amounts to the older leaves of bean and oat plants and then measuring the radioactivity of the young leaves that developed subsequently, it has been possible to compare the rate of growth of the two plant types when the young leaves of each contain equal concentrations of the growth regulator. Additional information which bears directly on this problem has also been obtained by studying the translocation of INBA in a third monocotyledonous plant, namely, corn seedlings.

The compound 2-iodo^{131}-3-nitrobenzoic acid was synthesized by diazotizing 3-nitroanthranilic acid and treating the reaction product with radioiodine 131.[2] A water dispersion of the compound was prepared by first dissolving the required amount in a small quantity of a commercial detergent (Tween-20) and then adding sufficient water to make a 4 per cent solution of the detergent in the final mixture. Measured amounts of the dispersion thus obtained were added to measured amounts of a 4 per cent solution of detergent in distilled water in order to make a series of clear, aqueous dispersions containing, respectively, 3.13, 6.25, 12.50, and 25.00 μg. of INBA/0.01 ml.

Bean and oat seedlings were grown from seed in potted soil under greenhouse conditions. Bean seedlings selected for uniformity were treated when the second internodes were not more than 1 mm. long but beginning to elongate. Immediately before treatment a thin layer of lanolin was smeared on the upper surface of one primary leaf of each plant in order to cover an area of about 1 cm.^{2} above the juncture of the petiole and leaf blade. This was done to block external movement of INBA from the treated leaves to other parts of the plant.

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[1] In the paper referred to it was tentatively concluded on the basis of the indirect evidence then available that INBA was absorbed and translocated as such in the plant. Since this work was published, it has been proved conclusively by the isolation of pure INBA from the stem and bud tissue of bean plants treated with this compound, that INBA is absorbed, translocated, and accumulated, at least in the bean plant, in the form of the intact molecule. While these experiments will be reported elsewhere, this fact is mentioned here to obviate the necessity for considering that a possible degradation product of INBA might be responsible for the results reported in this paper.

[2] Radioiodine was obtained through the Isotopes Branch, Manhattan District, Oak Ridge, Tennessee.

The oat seedlings were treated when they had developed one fully expanded leaf and a second leaf which was still partly enclosed in the leaf sheath. The third and fourth leaves were not outwardly apparent. Before treatment, lanolin was smeared across the upper and lower surfaces of the first leaf of each plant so as to cover a region extending approximately 1 cm. from the upper end of the sheath and toward the tip of the leaf.

Both the bean seedlings and the oat seedlings were divided into 5 groups of 30 plants each. The 30 bean and 30 oat seedlings in the first group of plants were used as controls, and each lanolin-blocked leaf was treated with 0.01 ml. of a 4 per cent solution of the detergent (Tween-20) in water. The solution was applied in each case to the upper surface of the leaf along the midrib in order to cover an area approximately 5 mm. wide and 10 mm. long in about the center of the leaf. The 30 bean and 30 oat seedlings in the other four groups were treated similarly by applying 0.01 ml. of a 4 per cent detergent-water dispersion containing, respectively, 3.13, 6.25, 12.50, and 25.00 μg. of radioactive INBA to each lanolin-blocked leaf.

For the study of the translocation of INBA in corn, the plants were grown from seeds in potted soil under greenhouse conditions. Fifty-one were selected for uniformity and treated when the first leaf was well expanded and a second leaf was partially expanded. The basal portion of the first leaf of each plant was blocked with lanolin by the technique described above on both the upper and lower surfaces and 0.01 ml. of a 4 per cent detergent-water dispersion containing 25.00 μg. of radioactive INBA was applied to the upper surface of each lanolin-blocked leaf.

Eight days later the treated leaves of the bean, oat, and corn plants were removed. Stems of the bean plants were severed at the second node, and all parts above the second node were collected. Each part was weighed individually, dried at 80° C. in a well-ventilated oven, reweighed individually, and then the parts were combined by groups and ground to 40-mesh for radioactivity measurements. The oat plants were severed at the uppermost end of the first leaf sheath, and all leaves above this point were weighed and processed as described for the bean plants. The corn plants were severed at the upper end of the first sheath and parts above this level were divided so as to obtain combined samples made up of the second, third, and fourth leaves, respectively. The corn leaf samples were processed as described for the bean plants.

Radioactivity measurements were made on 50-mg. aliquots of the dried, ground plant samples under rigidly standardized conditions using a Geiger-Müller scaling unit and a lead-shielded, Geiger-Müller counter tube having a thin mica window.[3] For measurement, the samples were placed in cylindrical stainless-steel cups having an internal diameter of 32 mm. and a uniform depth of 3 mm. Radioactivity measurements were also made under the same conditions on 50-mg. aliquots of each of a series of reference standards prepared by adding various known amounts of radioactive INBA to samples of tissue from corresponding parts of untreated bean, oat, and corn plants by the procedure previously described (*3*). The amount of INBA present in the experimental plant samples was calculated by relating the measured radioactivity in each case to that of a reference standard of comparable activity. Frequently interspersed measurements of the radioactive INBA standards also obviated correction for decay of the radioiodine (half-life period of I^{131} = 8.0 d.) during the experiments. Proper operation of the counting apparatus was checked routinely throughout the work by measuring the radioactivity of a radium D + E sample.[4] Background measurements (natural radioactivity) were also made at frequent intervals.

TABLE 1

Accumulation of INBA in Terminal Parts* of Bean and Oat Seedlings and Its Effect on the Subsequent Growth of These Parts

INBA applied per plant (μg.)	Dry wt. per plant terminal growth avg. (mg.)	Net activity per 50 mg. tissue (counts/minute)	INBA per 50 mg. dry tissue† (mg.)	INBA per plant terminal growth (μg.)
		Beans		
0.00	185.9	10	0.00	0.00
3.13	83.6	3,810	0.76	1.26
6.25	76.1	7,670	1.52	2.31
12.50	59.4	13,724	2.72	3.23
25.00	58.5	21,852	4.38	5.07
		Oats		
0.00	38.2	152	0.00	0.00
3.13	41.3	2,894	0.56	0.47
6.25	38.9	4,826	0.94	0.73
12.50	39.0	7,194	1.40	1.10
25.00	40.9	9,764	1.91	1.56

* All parts above sheath of first leaf of oat and above second node of bean plants are designated as terminal growth. This portion developed during the period of treatment (8 days).

† Based on standards made from dried leaves of bean and oat plants possessing average net activities of 5,047 and 5,123 counts/minute/γ of INBA, respectively.

The concentration of INBA in the most rapidly developing parts of both bean and oat seedlings increased progressively as the amount of INBA applied to the plants was increased (Table 1). In the case of the bean plant the accumulation of the compound in the terminal buds, even at the lowest level of applied INBA, resulted in a marked inhibition in the rate of growth of this tissue (45 per cent of control). At higher levels of application even greater inhibition in growth occurred, with maximum inhibition (approximately 32 per cent of control) attained upon the application of 12 or more μg. of INBA/plant (Fig. 1). In the case of the oat plant, however, no inhibition in the rate of growth of young leaves occurred, regardless of the amount of INBA applied to, and absorbed by, the plant.

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[3] The apparatus used had the following characteristics: counting circuit scale having 64 units, with a register circuit for operation of an external mechanical register; self-quenching, end-window-type counter tube having a threshold voltage of 1,200 and a mica window 28 mm. in diameter, with a thickness of 3.2 mg./cm.^{2}.

[4] The radium D + E sample used as a standard in these investigations was kindly furnished by L. F. Curtiss, National Bureau of Standards. The sample consisted of radium D plated on thin palladium foil. The absolute beta-ray activity of the sample, due essentially to radium E in equilibrium with radium D, was calculated by the Bureau of Standards to have a value of 147 microrutherfords (1 microrutherford = 1 disintegration/second, *1*).

Oat and corn plants absorbed and accumulated appreciably less of the applied INBA than did bean plants. For example, 8 days after the application of 25 µg. of INBA to bean and oat plants, the concentration of the compound per unit of dried oat plant tissue was only half that found in the young leaves and stems of bean seedlings. Similarly, in corn plants, where no inhibition in growth occurred, considerably less INBA was absorbed and accumulated in the young leaves than was absorbed and accumulated in bean plants treated with an equal amount of the compound. Nevertheless, because of the wide range in the amounts of INBA applied to the bean and oat plants, experimental conditions were attained in which the amounts present in the rapidly growing parts of the two plant types were identical, making it possible to compare the growth-inhibiting effects of this compound in these plants under strictly comparable conditions. This fact is apparent when the INBA accumulation curves plotted in Fig. 2 are considered together with the growth curves given in Fig. 1. Equal concentrations of INBA (1.9 µg./50 mg. of dried tissue) were present in the young leaves and stems of bean plants and in the young leaves of oat plants when the plants were treated with approximately 8.3 and 25 µg. of INBA, respectively. The growth of the young bean leaves and stems containing 1.9 µg. of INBA/50 mg. of dried tissue was reduced to 37 per cent of that of controls, whereas the growth of young oat leaves that contained an equal concentration of INBA was not at all affected.

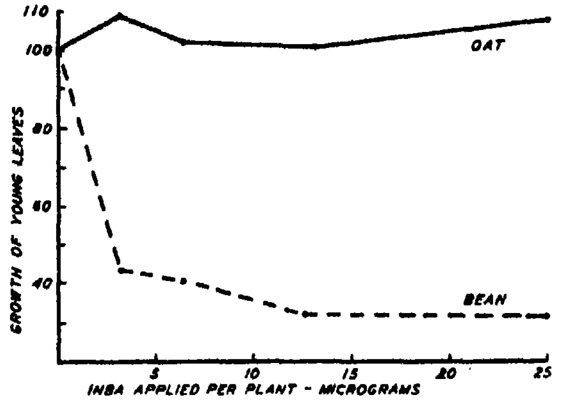

FIG. 1. Growth response of young leaves of bean and oat seedlings treated with different amounts of INBA. Values calculated on the basis of controls equal to 100 per cent.

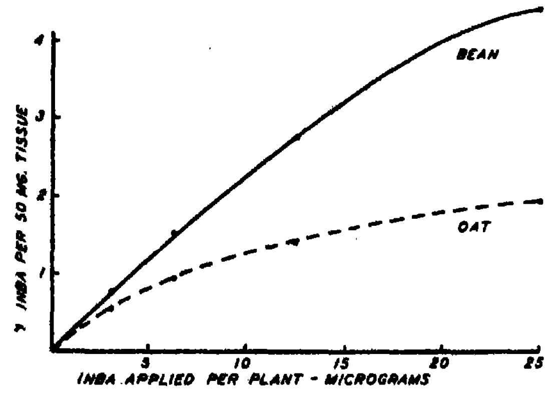

FIG. 2. Effect of applying increasing amounts of INBA to bean and oat seedlings on the concentration of the compound in the young leaves of each plant. (These curves yield essentially straight lines when plotted with logarithm coordinates.)

It can be concluded from these results that the difference in the sensitivity of bean and oat plants to INBA cannot be accounted for on the basis of differences in the ability of the plants to absorb and translocate the compound or on the basis of a difference in the extent to which INBA accumulates in the rapidly growing parts of the plants, since with equal concentrations in the young leaves of each type of plant the growth of bean was greatly reduced but that of oat was not affected. These results lend additional support to one of the two alternative conclusions previously reached (*3*), namely, that the growth-inhibiting effects of INBA in the bean plant and its failure to produce significant inhibition in barley, oat, and corn plants must be due to differences in the manner in which INBA reacts with the plant constituents in each case.

TABLE 2

ACCUMULATION OF INBA IN LEAVES OF CORN SEEDLINGS 8 DAYS FOLLOWING APPLICATION OF 25 µG. OF THE COMPOUND TO THE FIRST LEAF

Leaf in order of development	Dry weight per plant avg. (mg.)	Net activity per 50 mg. dry leaf tissue (counts/minute)	INBA per 50 mg. dry leaf tissue* (µg.)	INBA per leaf (µg.)
Second	49.6	5,298	1.27	1.26
Third	63.6	4,815	1.04	1.32
Fourth	31.8	3,621	0.78	0.50

* Based on standards prepared from corn leaves having an average net activity of 4,652 counts/minute/γ of INBA.

Three other implications of the experimental results are noteworthy: (a) Growth of the terminal buds of bean plants was reduced roughly in proportion to the amount of INBA accumulated in them until a concentration of approximately 2.7 µg./50 mg. of dry tissue was reached; at higher concentrations of INBA no greater inhibition in growth occurred. (b) INBA continued to accumulate in terminal buds of bean plants even after maximum inhibition had been attained. (c) In the case of the translocation experiments with corn seedlings, the concentration of INBA was greatest in the oldest leaf assayed and least in the youngest one in which the INBA content was determined. On the basis of these observations and other evidence to be presented at a later time, it is considered probable that INBA, and perhaps other plant-growth regulators of this type, not only accumulates primarily in the plant tissue that is developing most rapidly at the time the compound is applied, but also combines stoichiometrically and, for the most part, irreversibly with certain essential metabolites of these tissues to exert its growth-inhibiting effects.

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A Nutritional Disease of Oats Apparently Due to the Lack of Copper

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A deficiency of available copper in the soil is reported to have caused a nutritional disease of oats in Europe (*1*) and in Australia (*2*), but apparently this disease has not been reported in this country. However, a similar disease has appeared in oats planted on the Experiment Station Farm at Gainesville, Florida, and this report is concerned with the symptoms of the trouble and the remedy for it.

The oat variety, Florida 167, when grown on certain parts of the Experiment Station Farm, has exhibited for several years an apparent nutritional disease. Others varieties have been affected, although they have been grown to a lesser extent. The symptoms of this disease develop on this variety as follows: After being seeded at the usual planting time in November, the oats come up and at first appear normal. The only difference detected after about two months is that the affected oats are smaller than nonaffected plants. In later stages of growth, about three degrees of severity of the symptoms have been noted, namely, severe, moderate, and slight. In severe cases the leaves begin to show a characteristic marginal chlorosis early in February. As the disturbance progresses, the margin and tips of the leaves become brown or may look as if they have been scorched. Tillers begin developing about the middle of February. The emerging tips forming the bud of the tillers frequently are rolled up tightly, and the rolled-up part becomes light colored, then brown, and eventually may die. After that the entire plant may die or may struggle along, putting out new tillers which in turn develop similar characteristics. Such plants produce practically no heads and little foliage. If the condition is moderate, the plants will have some of the characteristics described above. New tillers develop late, which results in the plant material being immature at normal harvesting time. The oats produce heads, but instead of ripening to a normal yellow color, these heads tend to have a whitish-green color, and very little grain is produced. Slightly affected plants appear normal except for considerable blasting and light grain. Sometimes the upper leaves, which cover the head just as it emerges, are chlorotic and may even appear scorched. Symptoms of this nature on this variety have been observed on several farms in central Florida.

Affected plants seem to develop wiry roots that show root rot in various stages, but this is probably secondary in nature. There was no apparent difference in the amount of ***Helminthosporium*** leaf spot on affected and normal plants.

Field experiments, in which the Florida 167 variety was grown, were conducted in a badly affected area[1] in an effort to determine the cause of the abnormality. In one set of experiments a uniform liberal application of the major fertilizer elements, nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur, was applied. In addition to the major elements, copper, zinc, manganese, boron, and molybdenum were applied to the soil in all possible combinations before seeding the oats. The copper was applied as copper chloride at the rate of 10 pounds/acre. The seed were treated with New Improved Ceresan. In another experiment an assortment of treatments were tried including fertilizer, rate of top dressing with nitrate of soda, seed treatment with New Improved Ceresan, and the minor elements in combination with these.

Oats which did not have copper developed severe symptoms of the disease and produced practically no grain. The foliage was small, and very few plants even produced heads. Oats grown on every copper treatment were either free or practically free of the described disease and produced relatively good yields. The only treatment of value was copper. Top dressing with extra nitrate of soda seemed to accentuate the trouble.

Copper chloride which was applied in 1944 to old fertility plots and copper sulfate which was applied in 1942 had a pronounced residual effect on the yield of oats and largely prevented the disease. The disease was prevalent in other parts of the old fertility experiment.

A more detailed report will be published elsewhere.

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[1] The soil type is Arredondo loamy fine sand.

The Migration of Newly-hatched Loggerhead Turtles Toward the Sea[1]

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The initial adaptations of newly-hatched loggerhead turtles may be divided into three major behavioral sequences: (1) escape from the deep nest on the ocean beach; (2) direct migration to the sea immediately after escape; (3) orientation toward deep water once the ocean surf is reached.

The conditions of development of the loggerhead turtle preclude the possibilities of prenatal stimulation in determining the remarkable adjustments of the newly-hatched animal. The nest of these turtles, a hole in the sand about one foot in diameter and two feet deep, is installed in midsummer months by the adult female, which immediately afterward returns to the sea. Each nest contains from 50 to 200 eggs. After an incubation period of about 7 weeks the young turtles hatch, mill around in the nest for 3–5 days, emerge as a group, and make a rapid run for the ocean. Although the crawl from the nest to the water may cover a distance as great as 25 yards, no errors are shown in direction of crawl. Once in the water, the animals swim toward the open ocean. The escape from the nest, which occurs typically at night, is accomplished by slow activity in the nest, which raises the nest floor gradually to the beach surface by knocking sand from above.

The guiding physical stimuli which determine the nest-to-sea movements of the young loggerhead have been the subject of some previous investigations. Hooker (*2*) and Parker (*3*) have referred to positive geotropic reactions, visual hue discrimination and preference, and discrimination of visual "openness" (the uniformity of the ocean horizon) as possible means of explaining the oriented crawling.

In order to determine the critical stimuli for the directing of the migration in the young turtle, observations were made under natural conditions and in a privately arranged laboratory on the east coast of Florida.

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[1] Presented before the Midwestern Psychological Association and Section I, AAAS, St. Louis, March 1946.

The major results of these studies show that the newly-hatched loggerhead is activated and guided in its movements from the nest to the sea by photokinesis and phototropism, the critical stimulus for which is normally the light reflected from the ocean surf. The following observations will serve to indicate the validity of this conclusion.

TABLE 1

NUMBER OF TURTLES RESPONDING POSITIVELY TO SIMULTANEOUSLY PRESENTED LIGHT AND GRAVITATIONAL STIMULATION

Angle of incline	No. of animals tested	No. showing positive geotropic response	No. showing positive phototropic response	No. showing ambiguous response*
6°	16	1	8	7
10°	6	1	3	2
13°	11	2	8	1
Total	33	4	19	10

* This group includes inactive animals as well as 4 animals which moved in no particular direction around the release point on the inclined plane.

Neither sound nor smell of the water will direct the crawling movements when vision of the surf is prevented. Sixty newly-hatched animals placed in an open pit on the beach milled around but showed no oriented movements in the direction of the water. When vision of the surf was permitted by placing them on the open beach, they entered the water immediately. Four animals, released on the beach on a quiet, moonless night when the surf was absent, failed to find the water, but when released later, at the same point on the beach, after the moon had risen, they crawled quickly into the ocean.

A group of 5 animals placed on the beach at night were observed to follow a beam from a flashlight as it was moved around on the beach surface. Confusion of orientation was produced in a group of 50 turtles by releasing them on the beach on a moonlit night and by stimulating them simultaneously by a spot of light directed near them on the sand. About half of the animals followed the spot of light as it was moved about, and the other half crawled to the sea. Some individuals could be induced to reverse their direction of crawl, even after getting into the water, by moving the light from the edge of the ocean up onto the slope of the beach.

In the laboratory, the newly-hatched animals became very active when stimulated by ambient light, even of moderate intensity. Focal light stimuli in addition prompted the animals to approach and attack the light source. Turtles also showed an acceleration in approach time negatively related to distance from a focal stimulus. Circular crawling in the direction of the seeing eye was induced by temporarily blinding one eye and illuminating from above.

An approximate threshold of discrimination of light intensity was determined by observing the movements toward two light panels differing in brightness. They discriminated light ratios as low as 1:2 at an illumination level of 0.1 millilambert. This discrimination is smaller than the light differences typically occurring either at night or during the day between the surf and surrounding areas of beach and ocean.

Gravity as a stimulus was compared with light directly by releasing the animals on an inclined plane with a lighted window at the top. The results (Table 1) indicate that geotropism is relatively ineffectual. In a similar experiment, pairing light with sea water, the light approach again was dominant.

Further experiments were conducted to discover whether the turtles would crawl toward a "broken" visual pattern in preference to a "uniform" pattern, when opposed by a brightness difference favoring the broken pattern. Every one of a group observed approached the brighter but interrupted stimulus pattern in preference to the dimmer uniform field. This result pointed to an interpretation in favor of light rather than pattern as critical. As applied to the natural environment, this indicates that it is unlikely that the presence or absence of trees, shrubs, or sand dunes defines the seaward movements.

Inasmuch as the migratory nest-sea reactions normally occur at night under levels of illumination precluding the possibility of hue discrimination for the rod-cone eye, as is found in turtles, it was considered that hue discrimination could not determine the movement.

The previously reported embryonic study of development in the loggerhead (*4*) disclosed that the crawling and swimming movements evolve as specialized reactions within a matrix of more generalized body movements, and that these reactions, along with the migratory response pattern itself, may be elicited in animals prematurely released from the egg. The fundamental character of the oriented reactions was further established by the fact that the movements toward light stimuli are relatively unmodifiable through learning of a detour path in a Y-maze. The conclusion was clear from these observations that the light-induced movements were sufficient to account for the stereotyped character of the actual sea-approach behavior. Positive phototropism, conceived as a stage in maturation, is further suggested by the fact that the response becomes weak at about 6 days of age and a negative response to very bright light appears at about 3 weeks of age.

It may be concluded that the phototropic reactions to differences in light intensity and the kinetic effects of light, which may be observed under both laboratory and natural conditions, have significant relations with the environmental circumstances under which the nest-sea migration occurs. At night the white and sometimes phosphorescent surf constitutes the most intense light stimulus in the nest locale. This light is apparently the critical stimulus for both activating and guiding the ocean crawl. At dawn or dusk or, in fact, throughout the day, the brilliant surf also acts as a directing and motivating influence for the animals to reach the ocean. The observations showed that the positive responses to light are dominant and invariable during the first few days after hatching. In addition, it was observed that the female adult carefully selects nestsites which provide clear vision of the surf, and that other geographic features are not involved in the nest location.

The physical stimuli effective in leading the animal from the surf to the deeper areas of the ocean and the processes underlying these movements were not clearly defined.

These studies will be reported in full elsewhere (*1*).

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IN THE LABORATORY

Routine Analysis of the Alpha Activity of Protactinium Samples

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The classical method of measuring the alpha activity of protactinium consists of the following procedure: The samples containing protactinium are painted on metal discs as uniformly as possible and in extremely thin layers in order to provide minimum absorption for the alpha particles of protactinium. The current produced by the alpha particles of the sample is measured by an electrometer or electroscope and compared with that of a uranium standard.

The current obtained by the protactinium sample, expressed in e. s. u., is used for the determination of the number of alpha particles emitted by the sample:

$$J_{e.s.u.} = N \cdot e \cdot n, \tag{1}$$

where N is the number of alpha particles emitted; e, the electric charge of an ion; and n, the number of ion pairs produced by an alpha particle of protactinium along its path through the ionization chamber.

Knowing the half-life of protactinium, the number of alpha particles emitted by, for instance, 1 mg. of protactinium can be calculated. One mg. of protactinium emits in total (whole sphere) 1.85×10^6 alpha particles/second.

The fraction $\frac{2N}{1.85 \times 10^6}$ gives the amount of protactinium (in mg.) which the sample contains, provided that the absorption of the layer of foreign material can be neglected. However, this assumption can actually never be realized completely. Therefore, the maximum value of $\frac{2N}{1.85 \times 10^6}$ corresponding to a zero absorption has to be determined by extrapolation, measuring samples of decreasing total weight. The ratio $\frac{\text{current}}{\text{weight of sample}}$ increases with decreasing layer thickness and, plotting these values versus the weight of the samples, we obtain a curve whose intersection with the ordinate gives us the actual value of the protactinium content per unit weight of sample material.

It is evident that this method is time consuming and subject to various errors, especially if the sample is very dilute with respect to the protactinium content. Moreover, this method presents a great many difficulties in plants where other radioactive products are present, especially alpha radiators of shorter half-life than protactinium, because even the slightest contamination introduced in the process of painting the discs can give rise to great errors. If, for instance, in a sample of 1 mg. of protactinium/gram, only 10^{-6} mg. of polonium is present, the error in the determination of the protactinium content would amount to more than 10 per cent.

In order to overcome these difficulties, we decided to apply for routine measurements the method of measuring the samples in thick (alpha-saturated) layers, especially since it affords less handling of the material, which, after suitable grinding, is filled into special, strictly uncontaminated dishes.

The theory of the ionization, above alpha-saturated layers of material, due to its emission of alpha particles was given by R. D. Evans (*1*). The number of ion pairs, Nip, produced by the alpha particles emitted by 1 cm.² of the sample layer is given by

$$\text{Nip} = \frac{J}{e \cdot f}, \tag{2}$$

where J is the current due to the alpha particles of the sample; e, the charge of the ions; and f, the surface of the sample. As these samples contain much more material than the painted layers, a slight contamination does not affect the accuracy in such high degree and can be recognized more easily be refilling. The relationship between this number and the content of protactinium per gram of the sample Pa is given by the equation

$$\text{Nip} = \frac{L}{A_{Pa}} \cdot (EKR\lambda_{Pa}\text{Pa}d\mu). \tag{3}$$

In this equation L is the Avogadro number and A_{Pa} the atomic weight of protactinium; the radioactive constants, EK, R, λ, Pa which refer to the specific ionization and range of the alpha particles and to the disintegration constant of protactinium, have been tabulated (*1*). Therefore, Pa, the protractinium content per gram of sample, could be calculated if d, the density of the sample, and μ, the absorption coefficient for the alpha particles, *i.e.* the ratio between the alpha particle range in the solid to its range in air, are known.

The density of the sample can be obtained experimentally, but would require separate measurements; on the other hand, an experimental determination of μ presents quite great difficulties.

To overcome these difficulties and to establish simultaneously and once for all the value of the product "μd" for our special samples (ZrP_2O_7), we proceeded as follows:

(1) Very careful measurements were made using the first-described method of thin-layer samples in order to obtain directly the content of protactinium per gram of the sample. Thereafter, exactly the same sample of material was used in an alpha-saturated layer, and the product "μd" was calculated, substituting for Pa in Equation 3 the value found in the thin-layer experiments. The average value obtained in four series of measurements is: $\mu d = 2.36 \cdot 10^{-3}$.

(2) An accurately known quantity of polonium was added to ZrP_2O_7 samples of low protactinium content and later also

to unactivated ZrP_2O_7 samples.[1] The polonium was (a) added in form of a solution (HCl) and (b) precipitated on ferric hydroxide [$Fe(OH)_3$].

In case (a) the exact quantity of polonium was determined by spinning a nickel foil in an aliquot part of the polonium solution used for the experiment and by measuring this foil by photoelectric or ionization methods. The solution was thoroughly mixed with the zirconium sample and dried at only slightly elevated temperatures until the original weight was reached. Because of the high specific activity of polonium, no correction factor with respect to density changes have to be made. Two series of measurements gave the average value of $\mu d = 2.20 \times 10^{-3}$.

In case (b) a nickel foil with a well-known amount of polonium was dissolved and the polonium precipitated on $Fe(OH)_3$. By this procedure about 5 per cent of the original polonium quantity is lost, and this factor, as well as the change in density by adding approximately 10 mg. of $Fe(OH)_3$ to 1 gram of sample material, was taken into consideration. Six series of measurements gave the average value of $\mu d = 2 \cdot 10^{-3}$; this value is smaller than that in (a) and 11 per cent smaller than in case 1. In three series out of these six we measured only the quantity of added $Fe(OH)_3$ before the precipitation with polonium and did not observe the weight after having dried the sample. It might be that, because the drying was not complete, the value of density appears too small. On the other hand, the values of series 1 may be too high, as the samples were very dilute with respect to protactinium, so that the active material is covered with an absorption layer.

The average value of the three sets of measurements, $\mu d = 2.22 \cdot 10^{-3}$, was accepted and introduced in Equation 3, which now allows us simply to calculate the content of protactinium precipitated on ZrP_2O_7, if the sample is measured in alpha-saturated layers.

For routine measurements, the necessary calculations can be still further simplified by comparing the ionization above the protactinium samples with that appearing over the uranium standard. If the ionization effect is the same in both cases, assuming equal surfaces of the preparation, we find that the content of protactinium in the zirconium sample is 1.3×10^{-6} gram/gram of sample. Therefore, the protactinium content in grams per gram of sample can be expressed by

$$Pa = \frac{J_{ZrP_2O_7+Pa}}{J_{U_3O_8}} \cdot 1.3 \cdot 10^{-6} \text{ gram.}$$

The above considerations, of course, are valid only if the radioactive element is always separated by the same chemical processes, a common occurrence in routine work of this nature.

The use of polonium for the determination of the factor μd in the case of protactinium samples is self-indicating because of the nearly equal range of the alpha particles emitted by these radioactive elements. However, the same procedure can be recommended in the case of other alpha emitters of appreciable half-life, e.g. plutonium and other transuranic elements, since the addition of polonium, due to its high specific activity, does not alter the absorption in the sample.

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[1] We are grateful to W. R. Horn and M. Pavey, of International Rare Metals Refinery, Inc., for the preparation of all of these samples.

A Simple Quantitative Method for Intravenous Injection of Small Volumes of Fluid

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The intravenous injection of small, accurately measured quantities of solutions is frequently required in physiological investigations. In most of the reported studies the technic has consisted of using a syringe calibrated to contain the solution and final rinsing of the syringe with blood several times to insure complete delivery (*1*). In the course of a study of the distribution of radioactive and nonradioactive substances injected intravenously into small infants, a simple technic was adopted which has several advantages.

The arrangement of the apparatus, which consists of two ordinary glass syringes with Luer locks and a metal three-way stopcock,[2] is shown in Fig. 1. One or more solutions are delivered from sterile volumetric pipettes of desired capacity into the upright syringe barrel, A, with the stopcock handle, B, in position 1. After the vein is entered, the handle is turned to position 2, and the plunger of the horizontal syringe, C, is withdrawn, bringing the solution into the barrel. Returning the handle to position 1 and advancing the plunger into the barrel delivers the solution through the needle into the vein. The upright barrel can then be filled with saline to the height of the original fluid level and washed through the apparatus as many times as desired by repeating the above maneuvers.

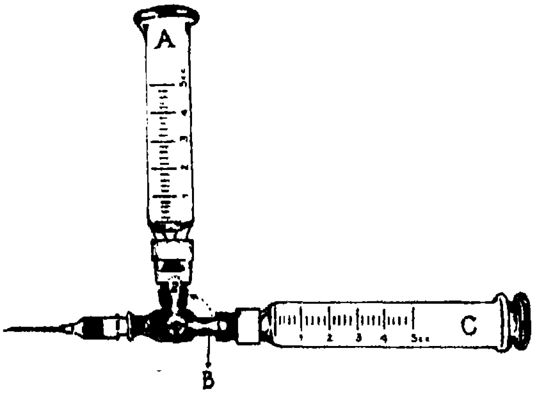

Fig. 1

One-ml. aliquots of four different solutions (thiocyanate, creatinine, mannitol, and sodium-*p*-aminohippurate[3]) were pipetted into the upright barrel of the assembly and then delivered through the apparatus into 2,000-ml. flasks. With two 4-ml. rinsings of the assembly into the flasks, concentrations of the four substances were found to be identical with those in flasks into which similar aliquots were delivered directly from the pipettes. Quantitative recovery was confirmed by finding no residual substances in additional rinsings of the assembly.

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[1] With the technical assistance of Dorothy Weber.

[2] This is the type commonly used for intravenous injections in pediatrics and is available from Becton-Dickinson & Company, Rutherford, New Jersey.

[3] The mannitol and sodium-p-aminohippurate were kindly supplied to us by W. P. Boger, of Sharp & Dohme, Inc., Philadelphia.

The difficulty of intravenous injections in small infants is not increased by using the arrangement of the syringes described. The technic has the following advantages:

(1) The volume or volumes of solution to be injected can be measured more accurately from volumetric pipettes than from calibrated syringes, and the former are more readily available.

(2) Several solutions can be measured quantitatively and given in a single intravenous injection.

(3) Rinsing is done with saline rather than aspirated blood. The small amount of additional fluid required to rinse the assembly will not, in most instances, introduce a significant error in the determination of fluid "spaces."

The last two items are particularly applicable to studies of infants or small animals in which multiple injections and rinsing with blood are difficult.

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A Crystalline Pituitary Protein With High Growth Activity[1]

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During current work on the fractionation with alcohol of calcium hydroxide extracts of fresh beef anterior pituitary glands we have obtained crystalline fractions with very high growth hormone activity. The procedure is briefly as follows: Dissected anterior lobes are frozen in solid carbon dioxide and ground to a fine powder. After the carbon dioxide has evaporated, the gland powder is suspended in calcium hydroxide solution, pH 11.5, and stirred vigorously overnight. This and all subsequent operations are carried out in a cold room at 0–5° C. The pH of the extract is adjusted to 8.7 by bubbling in carbon dioxide gas, and after the mixture has stood again overnight it is centrifuged and the residue is discarded. To the supernatant solution, vigorously stirred, 1:1 alcohol-water is slowly added. Successive additions yield 5 fractions: A, at pH 8.6 and 13 per cent alcohol; B, pH 8.6, 19 per cent; C, pH 6.8, 23 per cent; D, pH 4.6, 23 per cent; and E, pH 4.6, 40 per cent. The fractions are separated by centrifugation, resuspended in water, and lyophilized. To prepare crystalline material, fraction A or B is dissolved in calcium hydroxide, pH 11.5, to make a 0.5 per cent solution, the pH is adjusted to 8.6 with carbon dioxide, the solution is centrifuged, and to the supernatant solution, vigorously stirred, enough 1:1 alcohol is very slowly added to make an alcohol concentration of 7 per cent. The crystals, which impart a beautiful silken sheen to the solutions from which they appear, seem on microscopic examination to be very thin, rectangular plates, many of them broken because of the shearing stresses of the vigorous stirring which is necessary during the addition of the alcohol. They are centrifuged off, suspended in water, and lyophilized. In the first experiment, starting with 304 grams of fresh glands, the yield of crystalline material from a portion of fraction B was 200 mg. In the second experiment, in which 350 grams of fresh glands were used, the yields were 74 mg. from fraction B and 950 mg. from fraction A.

The three crystalline fractions so far obtained have been assayed by the 10-day growth test on hypophysectomized rats. Their activities were compared with that of a purified growth hormone preparation made by us according to the method of Li, Evans, and Simpson (*1*). The results are summarized in Table 1.

TABLE 1

Fraction	No. of rats	Dose/day		Mean weights of rats (grams)		
		(mg.)	(mg. N)	Initial	Final	Change
30A	3	0.020	0.0032	194	212	+18
49A	3	0.100	0.0147	92	117	+25
	3	0.010	0.0015	95	108	+13
50A	3	0.100	0.0142	91	112	+21
	3	0.010	0.0014	87	98	+11
Li	2	0.099	0.0131	95	120	+25
	3	0.010	0.0013	91	108	+17

Autopsies carried out on the test animals showed that the weights of the thyroids, adrenals, testes, seminal vesicles, prostate, and liver were not different from the weights of these organs in uninjected controls. Histological studies on the thyroids are not yet complete. In the tests with fractions 49A, 50A, and the Li preparation the widths of the tibial epiphyseal cartilages were also measured. These were in μ: for 7 controls, 125; for 49A, 50A, and the Li preparation, at the 0.1-mg. dose level, 320, 309, and 379, respectively; and at the 0.01-mg. dose level, 291, 270, and 278, respectively. These results provide an additional measure of the activity of the crystalline preparations.

The three crystalline fractions have been examined electrophoretically in phosphate buffer (ionic strength, 0.2) at pH 8.0. Two components were noted in each instance. Additional electrophoretic studies on recrystallized material are in progress, experiments are under way to determine whether the two components can be separated, and further work is being done to determine the maximum yield of active material obtainable by the new method.

The results so far indicate that crystalline preparations comparing favorably in growth activity with the purified hormone can be prepared in excellent yields by a relatively simple alcohol fractionation of an alkaline extract of anterior pituitary glands. Although not all of the fractions obtained have been studied thoroughly, it is hoped that the procedure may lead to the isolation in pure form of other active principles of the anterior pituitary gland.

Reference

1. Li, C. H., Evans, H. M., and Simpson, M. E. *J. biol. Chem.*, 1945, **159**, 353.

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[1] The work reported in this paper is being done under a grant from the American Cancer Society on the recommendation of the Committee on Growth, National Research Council.

Exchange of Carbon Dioxide Between Barium Carbonate and the Atmosphere[1]

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It was observed that precipitates of barium carbonate ($BaC^{14}O_3$ + $BaC^{12}O_3$) used as standards for radiocarbon (C^{14}) measurements appeared to lose a significant amount of radioactivity when stored for several weeks in contact with air in covered Petri dishes. In an experiment designed to test these observations and in which the Geiger-Müller counts were referred to a uranium standard a sample of radioactive barium carbonate lost 2.7 per cent of its original activity in 6 days. These findings could be explained as being the result of the incorporation in the precipitate of $C^{12}O_2$ from the atmosphere in exchange for $C^{14}O_2$. A mechanism for the exchange was postulated as follows:

$$C^{12}O_2 + H_2O \rightarrow H_2C^{12}O_3$$
$$BaC^{14}O_3 + H_2C^{12}O_3 \rightarrow BaC^{12}O_3 + H_2C^{14}O_3$$
$$H_2C^{14}O_3 \rightarrow H_2O + C^{14}O_2$$

Evidence that the exchange occurs and that the hypothesized mechanism is correct was obtained when it was demonstrated that (a) no loss of radioactivity by barium carbonate occurs in the absence of water vapor or carbon dioxide, and (b) radioactive carbon dioxide is released to the atmosphere, when the exchange occurs, in an amount equivalent to the decrease in radioactivity of the barium carbonate.

Precipitates of barium carbonate containing radiocarbon with the weights shown in Table 1 and surface areas of 5.73 cm.^{2} were collected in brass, Buchner-type funnels, as previously described (*1*). After the radioactivity of the precipitates had been measured with a thin mica window counter, each funnel and precipitate was separately placed in a vacuum desiccator of 2-l. capacity under the conditions indicated in Table 1. In Experiments 1 and 2 the bottom of the desiccator was covered with a layer of acidulated water in order to saturate the atmosphere of the container with water vapor. In Experiment 3 the air in contact with the barium carbonate was kept dry by a layer of phosphorus pentoxide covering the bottom of the desiccator. The gases ($C^{12}O_2$ or N_2) were admitted in sufficient amount to restore the pressure to atmospheric after the desiccator had been exhausted with a water pump. After the times indicated, the carbon dioxide present as a gas in the desiccator was collected in sodium hydroxide solution and the carbonate of the whole of this solution, or of an aliquot, precipitated as barium carbonate (*1*). The radioactivity of these precipitates and of the original barium carbonate, after drying and reweighing, were then determined. The activity of all samples was corrected for changes in counter performance by reference to counts of a uranium standard which was counted at least four times alternately with each sample.

The total activity of the precipitates, all of which were "thick" samples, were calculated by multiplying the observed count, corrected for counter performance and background, by the ratio of the thickness of the precipitate (expressed as mg./cm.^{2}) to 20. The relatively large statistical error shown for the radiocarbon found in the desiccator gas in Experiment 1 is due to the fact that the large amount of carbon dioxide necessitated counting a barium carbonate precipitate which contained only $\frac{1}{20}$ of the total carbon present in the gas phase of the desiccator.

In Experiment 1 the original precipitate lost 37.4 per cent of its radioactivity and, within the limits of experimental error, all of the radioactivity so lost was recovered as carbon dioxide in the atmosphere above the precipitate. The loss in weight of the precipitate after the treatment is probably within the experimental error of weighing the brass dishes and would account for no more than 1.74 per cent of the decrease in radioactivity. In other trials similar to Experiment 1 radioactivity equivalent to 12–48 per cent of the total was lost by the precipitates in 48–60 hours.[2] These results, obtained in the presence of water vapor and carbon dioxide, and the fact that no loss of activity occurs when barium carbonate is treated as indicated in Experiments 2 and 3, are evidence that the mechanism postulated above is correct. Under the conditions of these experiments it appears that the exchange, as in Experiment 1, occurs uniformly throughout the precipitate, since thorough mechanical mixing of the barium carbonate after

TABLE 1

Effect of Water and Carbon Dioxide on Loss of Radiocarbon by Barium Carbonate (t = 22° C.)

Exp. No.	Treatment		Original weight of precipitate (mg.)	Weight of precipitate after treatment (mg.)	Total activity of precipitate (counts/minute)*		Total activity recovered in $C^{14}O_2$ in desiccator*
	Conditions	Time (hr.)			Before treatment	After treatment	
1	$H_2O + C^{12}O_2$	65	178.1	175.0	1,782 ± 19	1,115 ± 16	620 ± 90
2	$H_2O + N_2$	71	176.3	176.3	1,710 ± 18	1,693 ± 18	B.G.†
3	$P_2O_5 + C^{12}O_2$	41	157.5	157.0	1,448 ± 16	1,460 ± 16	B.G.

* The activity results are shown ± the square root of the sum of the squares of the errors of the sample and background.

† B.G. = Not significantly different from the background count.

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[1] This work was carried out with the aid of grants from the John and Mary R. Markle Foundation and the Graduate School of the University of Minnesota.

[2] A sample of enriched C^{13} barium carbonate containing 2.86 atom per cent excess of C^{13} was subjected to similar treatment. The atom per cent excess of C^{13} was reduced to 2.64, showing that a definite exchange with atmospheric CO_2 had occurred. Since the $C^{13}O_2$ released was diluted 75-fold, it was not possible to ascertain with accuracy the resulting increase in C^{13}/C^{12} ratio in the atmosphere of the desiccator, although qualitatively this gas showed an enriched C^{13} content above its original composition. The enriched $BaCO_3$ and the analyses were kindly provided by Alfred O. Nier, Department of Physics, and Nathan Lifson, Department of Physiology, University of Minnesota.

the treatment caused no change in activity. This would not have been the case had the exchange occurred only on the surface layers of the precipitate.

These observations indicate the necessity for preserving carbonates which, in the solid state, are to be used as isotopic carbon reference materials in such manner that carbon dioxide or water, or both, are excluded from contact with the solid substance. Further, the observations confirm the possibility that one of the paths by which sunflower leaves absorb carbon dioxide from the air is by exchange of carbon dioxide with insoluble carbonates in the leaves (*2*).

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The Use of Isotopes to Determine the Rate of a Biochemical Reaction[1]

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Radioactive and stable isotopes are being used increasingly to determine the rates of biochemical reactions for which suitable techniques were previously not available. The theory of this application of isotopes has been discussed by Zilversmit and his collaborators (*2*) and by Branson (*1*). Both formulations show that in order to determine the rate for a substance, B, formed from A, the experimenter must have information on the time dependence of A and B.

Branson's integral equation formulation gave

$$M(t) = M(0)F(t) + \int_0^t R(\theta)F(t-\theta)\,d\theta,$$

where M(t) is the amount of substance present at time t; M(0) is the amount initially present; F(t) is the "metabolizing" function—the function which multiplies the original amount to give the amount present at time t; and R(t) is the rate of accumulation. The equations applicable to the system A → B, where A is transformed into B by a first order chemical reaction, are:

$$\begin{aligned} A^*(t) &= \int_0^t R(\theta)F(t-\theta)\,d\theta \\ B(0) &= B(0)F_1(t) + \int_0^t R_1(\theta)F_1(t-\theta)\,d\theta \qquad (1) \\ B^*(t) &= C\int_0^t A^*(\theta)F_1(t-\theta)\,d\theta, \end{aligned}$$

which assume that the amount of B present is constant and R = CA. The starred quantities refer to the substances isotopically tagged. Hence, if we are interested in the R and F associated with B(t), we must determine experimentally $A^*(t)$, $B^*(t)$, and B(0).

The procedure is open to severe criticism in most complex biological systems, for it requires the unequivocal proof that B is the exclusive product of A. In general that will not be true; and, if it were, the scheme would be difficult to establish. Under the dynamic conditions existing in biological systems, we can expect side reactions and complex chains, some of which may lead eventually from A to B.

One procedure for eliminating the dependence upon measurements of $A^*(t)$ would be to introduce the tagged substance suspected as being the precursor of $B^*(t)$ in one system or series of animals and the tagged substance, $\overline{B}(t)$, in a similar system. From the first system we have

$$B^*(t) = \int_0^t R(\theta)F(t-\theta)\,d\theta \qquad (2)$$

and from the second,

$$\overline{B}(t) = \overline{B}(0)\ F(t), \qquad (3)$$

which are sufficient to determine F(t) and R(t) without dependence upon precursors of B.

Although of value, the preceding technique is probably as vulnerable as the first, since the measurements are made upon different systems. The experimenter would have greater confidence in his rate determinations if they were based solely upon measurements of the substance under study and limited to simultaneous measurements in a single system.

These desired conditions may be obtained by the use of a doubly-tagged[2] substance in a single system. We may introduce the suspected tagged precursor of B and follow experimentally the level of $B^*(t)$. At the same time, we may inject some $\overline{B}$—that is, a small amount of the chemically similar substance but tagged by the use of a different radioactive isotope or by a rare stable isotope. Thus, Equations 2 and 3 permit the simultaneous determination of R(t) and F(t) in a single system by measurements of B alone.

The number of possible combinations of isotopes available depends in large measure upon the problem and the skill of the experimenter. Under all circumstances, radioactive and stable pairs such as (H^2, H^3), (C^{13}, C^{14}), (S^{34}, S^{35}) and the radioactive pair (Fe^{55}, Fe^{59}) can be used for these elements. No appropriate radioactive member exists for oxygen or nitrogen; however, in many experiments they can be coupled with hydrogen, carbon, or sulfur. The assays will require the simultaneous use of the mass spectrometer and the Geiger-Müller counter, but such equipment is now rather widely available.

Experiments of this type are being planned for our laboratory using a small 60° Nier Type spectrometer and conventional Geiger-Müller equipment.

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[1] This work is being supported in part by a grant from the Research Corporation of New York.

[2] "Doubly-tagged" designates a substance, part of whose molecules are tagged by one isotope and part by another; e.g. methionine, with some molecules having S^{34} and some S^{35}, or betaine, with some molecules having N^{15} and some C^{14}.

Some Problems of Human Ecology in Polar Regions

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THE PROBLEMS OF MAN IN THE ARCTIC and Antarctic are under examination by many. These are of special interest to the ecologist or environmental physiologist.

The field of interest of the environmental physiologist can be briefly described as the reactions of normal man to the complex of natural and artificial factors of the environment. Physiology is the study of function of living matter. It includes the study of the human organism, an exquisitely integrated mechanism, the behavior of which is essentially the summation of actions and interactions of a mass of living cells, of groups of specialized cells called tissues, of combinations of tissues to make body organs; of body organ systems, of the organism as a whole, and of the interrelation of organisms (men). These reactions and interactions are continually influenced by physical, chemical, and emotional factors of the environment—internal and external.

The environment includes everything, and at the technological level of our present-day culture, with its dependence upon highly complicated machinery, with extremely artificial environments of technical and industrial areas, and with means of transport so rapid that man can be moved within an hour from desert torridity of 135°F. to the frigidness of the stratosphere of 65° below zero, the extreme range of physical impacts which confront man has no counterpart in history.

In spite of our superb machine and engineering developments, man in the final analysis, and man alone, is the focal unit of our functional society. Men, not machines, make our Nation.

The basic interest of the human ecologist is the study and understanding of the responses of the normal man to the multiplex factors of climate, cloister, and clothing, of factory, field, and fairway.

The polar regions are frontiers for investigation of descriptive natural sciences. They are also regions which offer unlimited opportunity for the integration of the man's capabilities and limitations with engineering design and development. The areas demand a continuing concern of man's reactions to the environments by the engineer, the economist, the geographer, and frontiersman; they demand a continuing concern of the geographical parameters of the physical and biological factors by the biologist, the engineer, the community planners.

In March 1946, the Arctic Institute of North America published Bulletin No. 1, entitled, *A program of desirable scientific investigations in Arctic North America*, a statement which was presented in the hope that it might serve as a working agenda and as a guide in planning a comprehensive program of Arctic research in North America. By design, problems related to human biology, including medicine, were omitted.

An outline of a program for similar research, but in the fields of human biology, is presented in this paper in order to invite comment and to indicate directions which the study of man in polar areas may take. A large section of this program applies only to the Arctic; the fundamental differences between the Arctic and Antarctic in regard to the habitability and inhabitation are the essential basis for this orientation.

It should also be noted that investigations are included which deal specifically with physical factors of the environment. The study and understanding of these are essential for the evaluation of man's reactions to the environment. Their inclusion in this biological program emphasizes the need for close integration of all fields of study when an analysis of the polar regions is made.

The first problems which will be considered can be grouped under the heading of *personnel.* These encompass the establishment of criteria for selection of persons to be engaged in polar work (and thereby, of course, the establishment of the validity of selection) and the study of needs and methods for special training and selection.

An approach to the selection requirements upon which to base the choice of personnel for Arctic service can be made through the study of present inhabitants. The motivations, personalities, and adjustments of men and women who have gone into the Arctic, and stayed or returned after a period, can supply a basic amount of generalized data for most types of duties which might be expected in military or civilian colonization of the North. The study of groups such as exist in villages or towns and in mining and lumbering camps can reveal significant comparative information which may be related to selection of personnel for establishing large aerodromes, camps, or colonies. The hunter-trapper personality may suggest standards for the selection of isolated outpost personnel like that needed for radio stations, emergency

The opinions expressed in this article are the author's and do not constitute official opinion of the Navy Department.

airfields, and ranger posts. The crews of a number of small Arctic trade and cargo vessels which ply the polar fringe seas may be fair sample material for basing selective methods for men to be assigned such duty if the demand becomes greater. A psychological evaluation of the bush pilot, one of the outstanding groups of present-day pioneers, should give an extremely valuable picture which could find ready translation to selection of North country pilots.

It is probable that in many instances the population sample will be inadequate for a complete study; nevertheless, initial directions should evolve from the analysis of present inhabitants. Assuming that the psychosocial study of present non-native Arctic populations reveals the existence of selective characteristics which can be generalized, then the establishment of criteria for selection of personnel for Arctic service (civil and military) will naturally permit a series of validating experiments only if selectees or volunteers for service in the Arctic are available. Government channels, again including military and nonmilitary personnel, will be the potential source.

In the course of establishing the need for preselection (and selection) standards and the validation of criteria for selection, a number of important correlations should be explored. The "traditional" emotional disturbance associated with Arctic isolation will demand reexamination. No doubt can be raised regarding the fact that some men cannot tolerate "Arctic isolation," but there is no evidence which clearly associates the development of the instability with the Arctic rather than with the isolation. If both factors are involved, there are as yet no data for assigning relative weights to each.

These broad psychosocial studies should also permit the investigation of two other areas of interest: the relationship of an experiential component of personal history with adjustment to Arctic service, and the relationship of motivation to emotional stability. Many persons who have never seen the Arctic have experienced conditions and situations as severe as, or even more severe than, those encountered in the upper latitudes. How residents of the Dakotas, Montana, Idaho, and some provinces of Canada compare in their adjustment to the Floridian and Californian should be of interest. It must be recalled that many Arctic whaling ships were manned by West Indians, Portuguese, and Mediterranean natives; and of the five men who reached the North Pole with Peary, four were Eskimos and one, Matthew Henson, was a Negro.

As for motivation in relation to adjustment to the Arctic, history is heavy with the achievements against adversity by highly enthusiastic explorers. There is little basis for suspecting factors of the Arctic which might tend to mitigate the forcefulness of motivation in overcoming difficulties, real or imaginary.

The development of methods of training and indoctrination of candidates for Arctic service offers a challenging field for educators who are interested in two rather diverse problems. The simpler is training by methods of simulation (artificially reproduced situations which can be controlled). The evolution of satisfactory methods for simulated training for Arctic jobs, whether engineering, farming, maritime, or community planning, should result in accelerated and economical preparation of men and women for Arctic service. For actual field training to begin with the primer problems is costly and inefficient.

A challenge greater than the simulated training is the indoctrinational program. Few areas of importance have a greater lore of fable than the Arctic, and generally well-informed persons are either uninformed about the Arctic or, even worse, ill informed. A program for indoctrinating people about the Arctic will, perforce, require not only the learning of facts but also the unlearning of fiction. In spite of our inheritance of information, the Arctic Circle does not demark the Arctic, the Arctic is not characterized by six months daylight and six months darkness, the lowest temperatures recorded on the earth are not in the Arctic, and Eskimos do not generally trade wives.

To the educational research in methods for simulated training and for indoctrination should be added research to develop effective survival teaching. Although this may be of primary importance to limited military groups, it should find broad application for transpolar air travelers, crew and passengers alike. Emergency landings in the Arctic are relatively safe compared to those on open seas; nevertheless, a basic understanding of survival methods is essential.

Another large field in need of investigation is related to *factors of the environment*. As indicated earlier, although this is a discussion of a program in human biology, the ecologist must make a critical examination of the physical as well as the biological factors. It will be clear that many physical assays of the environment which are proposed for study in the polar regions are also unknown for temperate zones. In the polar areas, the impact of these factors are so sharp that the biologist must have a clear picture of all the physical factors of the environment. The relation of some of the factors to biological problems will be commented upon in some instances, but a thorough development of this thesis cannot be made here.

The study of meteorological factors is of import; and the relationship to climate is obvious. Polar meteorology for the biologist must be a long-term, continuing study and must be carried out at an adequate network of observatories. In spite of a common tendency to think of polar meteorology as homogeneous, the fact remains that the range is great and the heterogeneity is general.

The physical measurement of solar radiation is essentially a problem of geophysics. But the importance of knowing the spectral range and the intensities of radiant energies in the polar regions warrants an active interest by the physiologist. Such radiant energy is highly complex and variable, for it may originate from direct sunlight and from light that is either diffuse or reflected, or from snow or ice, or it may be refracted from vapor. Polar mirages, sky maps, effects of snow-polarized light, and intensity of total lunar and stellar light for winter activity have to be studied.

Sound and noise levels may be so low that footsteps on the snow several hundred yards away are audible; or they may be of unearthly magnitude when pack ice is breaking up, churning and crashing.

Against quietude, the shrill call of the loon is enervating. Background noises, such as special sound of winds, aircraft, tractors, and the like in the low temperature of polar winters, have not been measured.

Physical phenomena, such as cosmic rays, aurora, and geomagnetism, are of significant interest to the geophysicist. His findings may be worth the attention of the physiologist, but the field is unexplored.

Humidity, fog, icing conditions, winds, water currents, ice, snow, topography, terrain, barometric pressure, and similar factors influence biological behavior. The study of the effects of these conditions on the organism cannot be logically pursued until the values of the factor are ascertained. Again, one must warn against assuming or expecting uniformity throughout polar regions. Not only are the Arctic and Antarctic very different in many respects, notably with respect to mean altitude of land surfaces, but also various parts of the Arctic may differ in almost all regards, except for the few or even for the single character chosen to define the entire polar region.

The assay of biological factors of polar environment will find its greatest share of interest in the Arctic since, except for fringe waters, the Antarctic, like the Greenland Ice Cap, is quite devoid of life. The first phase of a bioassay of polar regions by the ecologist should be a climatological analysis. Systematic study of climatic factors for the various polar areas is being pursued, but on far too modest a scale to allow a clearly defined presentation of Arctic and Antarctic climates.

The strict study of flora and fauna, which may fall more clearly to the plant and animal biologist, has had a share of attention, but, as indicated in the program of the Arctic Institute of North America (Bulletin No. 1), a great deal is yet to be investigated. The study of animal and plant life in the polar regions having environmental impact on man can be carried on almost without limit.

Bacteriological aspects of these geographical areas present a challenging opportunity. It is known that bacterial processes are retarded, but whether this is due entirely to temperature factors is not clear. Surveys of the bacterial content of the air, soil, snow, ice, inland waters, and sea should be conducted. The metabolism of the bacteria which are indigenous in the polar regions, their culture characteristics, and their pathogenicity (or nonpathogenicity) offer the field-minded bacteriologist and the human ecologist an intriguing problem.

The study of the extent, behavior, growth, and reproduction characteristics of the insect populations in the Arctic will afford valuable information for the control of the pestiferous insects like the Arctic mosquito and sand flies, but even more, it may offer a field for studying basic biological processes under special natural environments. A fundamental approach to relation of environment to genetic changes is being carried on by a study of the *Colias* in the Arctic by W. Hovanitz (personal communication).

Although an exhaustive search of the literature has not been made, the writer believes that no virological survey of the Arctic has been conducted. The environmental physiologist will be interested in such investigations.

Both the botanist and the ornithologist have been in the field, and of all the special phases of biology these two have carried out the most work; the greatest share of this has been descriptive, however, and there is, as with animal forms, a potential wealth of information regarding the physiology of polar plant life.

The rewards to the human ecologist for interest in Arctic vegetation can be found in regard to nutritional value of the vegetation, toxins, fuel utilization, cultivative potential, and even pharmaceuticals.

Mammals have been of economic interest, mostly for pelts and in some few instances for food. Scientific inventory and population analysis on a large scale should be of interest with respect to food, fur, domestication, pack and work use (dogs, reindeer, ponies), species balance, and basic animal ecology. It is interesting to note in passing that animal trails or runs across permafrost (permanently frozen ground) influence the permafrost character by the wearing off of the top insulating grasses.

It should be emphasized that the comments regarding plant and animal life are made with reference to the biological status of the polar regions to the extent that they constitute a series of factors of man's environment. The natural habits of the mosquito in the Arctic are of intrinsic interest, but the mosquito problem, as pest or potential disease vector or for control and irradication, is the one posed in this paper. The behavior of bacteria in Arctic regions is a challenging study, but the problem herein presented is mainly bacteria (pathogenic and nonpathogenic) as they constitute a factor of the environment.

A third general field in need of investigation in polar regions is *health and sickness*. Most of this work is pointed to the upper latitudes, since human inhabitation of the Antarctic continent is limited to explorers. The study of health of the native and the long-time white resident (trader, missionary, bush pilot, trapper, and civil servant) has been touched but very slightly. Medicoethnological studies have been conducted in limited phases, chiefly dental, general dietary, and some infectious diseases, but a critical and extensive examination of the historical aspects of the health status has yet to be made. The medical observations incorporated in the writings of early explorers and travelers have not been assimilated in a single body of information.

More attention is now being directed by governmental agencies to medical studies associated with Arctic and sub-Arctic regions, e.g. by the Interior Department in Alaska, by the Department of Mines and Resources in Canada, by the Danish Government in Greenland, and by the Northern Sea Route Administration in the Arctic and sub-Arctic USSR. The data, however, are still meager and sporadic. Public health surveys have concentrated heavily on tuberculosis; but the field is open for thorough and extensive disease surveys and control, medical requirements, and medical climatology and geomedicine.

From the purely medical viewpoint, the Arctic offers an extremely fertile field of inquiry regarding epidemiology, incidence, mortality, and morbidity of many diseases. The nutritional aspects of the Arctic population and the study of contagious diseases, endemic and epidemic, of diseases and natural growth of childhood and adolescence, of cancer, and, of course, longevity constitute a small share of the problems still unsolved. Hypertension, and cardiovascular disease in general, has reportedly a very low incidence, but precise data are not readily available. Most specialties of medicine such as dermatology, internal medicine, endocrinology, ophthalmology, gynecology, and urology will find interesting data when the native and the long-time immigrant population is studied. The responses of newcomers to the Arctic should reveal data pertinent, not alone to the specific disease groups, but also to the general aspects of physiological adjustment.

Some specific diseases which may be of interest to the field of Arctic or polar medicine will include pneumonia, tuberculosis, typhoid fever, rheumatic fever, allergy, arthritis, nephrosis, myositis, chilblain, frostbite, and snow blindness.

Because of the relatively limited population and the capacity to isolate whole villages, the work of the Public Health doctor, especially in Greenland, has been effective and instructive and, when accepted as an example to indicate potential fields of inquiry, is most stimulating.

We pass now from our consideration of the general medical and health status evaluations of the peoples of the Arctic to more specific *physiological problems* which are in need of investigation. First are those related to the assessment of health in the polar regions. Longitudinal studies—that is, long-term studies conducted on individuals over a significant part of their growth or longevity periods, rather than short-term studies of many persons of different age groups—will be revealing, especially in regard to the growth and development of the native. The physiologist interested in the child and adolescent has an opportunity to study not only growth in relation to nutrition (of different quality than temperate zones) and to special seasonal and climatic conditions, but also psychophysiological developments within a cultural group which treats its children with a real acceptance of the child as a person.

The physiology of adaptation or adjustment, or somatic learning, or even acclimatization is indeed a challenging problem, whether the process be real or imagined. The reactions of the organism, as a whole or as separate parts (as, for example, the peripheral vascular bed of weather-exposed parts of the body), to polar climatic factors have not been measured. The processes of wounding and wound healing, of disease susceptibility and recuperance, appear to be altered in polar regions. Critical evaluations have as yet to be made. It may be added that, although many physiological changes associated with lowered environmental temperature have been investigated, there are many factors of the polar environment in addition to temperature which may play significant roles. Actually as for temperature, indoor temperatures in the upper latitudes are usually maintained much higher than farther south; and outdoor clothing is usually adequate to keep northern residents more comfortable in below-zero weather than Eastern Seaboard inhabitants are likely to be in ordinary street clothing in above-zero winter weather.

An intriguing psychosomatic problem of Arctic life is the general acceptance of reality as a basis for behavior. Rigid schedules are not maintained, the elements of weather are not combatted, and, all in all, the pace shifts with the environmental factors. One should point out that this is a pattern of the native and long-time inhabitants and not necessarily true for the newcomer.

Some more specific physiological problems which present themselves include the effects of solar radiation (of polar intensity, range, and duration) on the eyes, skin, and body-temperature regulation; nutritional requirements for the low temperature and strenuous activity that are encountered on the trail; water balance among natives and white man; mineral balance, especially in the light of low salt contents; calcium source (in growing children); vitamin requirements; and the fat, protein, and carbohydrate relationships. In the case of these last problems the fish and meat-eating Eskimos of King William Island region offer a valuable source of information. In addition, postural gait and orthopedic studies in general will be interesting, for leather-arch supporting shoes are not used either by the natives or by the white man on the trail.

The cardiovascular balance of the polar inhabitants, kidney function, neuromuscular reactions, fitness in general, and psychomotor and sensory responses appear to warrant closer examination. It is not unreasonable to expect productive results from almost all phases of human physiological investigation which may be conducted on the inhabitants of the Arctic regions.

A very practical broad field of inquiry which involves the physiologist is that related to engineering, especially engineering in regard to man's employment of machine, or machines for man. In this area fall the problems of food, hygiene and sanitation, clothing, transportation, and community planning.

The *engineer-physiologist problems* regarding food (exclusive of the production of food that would be the province of the agricultural engineer) are related to food storage, processing for Arctic use, preparation, packaging, messing facilities, and special rations (pemmican and others) for emergency use. Problems in hygiene and sanitation include water supply, sewage disposal, housing (heating, ventilating, humidity control), laundry requirements, and the like. Humidity control in the dry, cold climates is an important problem, for in the usual condition which exists in northern houses the heated dry air causes the upper respiratory passages to become dehydrated. Not only is this very annoying, but it also makes one more sensitive to invasion of infectious agents when these agents happen.

The engineer-physiologist team must also attack problems of devising and improving transportation vehicles from the standpoints of operation design, maintenance convenience, and human factors in the vehicle design—heating, vibration control (for riding over rough tundra, sastrugi, and ice), noise elimination, removal of noxious gases, comfort, and safety aspects. The design and development of the best clothing for over-all use also demand the cooperation of the engineer and the physiologist.

Finally, for community planning, whether the community be a mining camp, an aerodrome, or a sizable village, the problems demand a combined attack by the human ecologist, the engineer, and the geographer.

To the writer, the essential and demanding requirement that the various disciplines of science and technology work together is one of the most exciting aspects of research in polar regions.

A System of Nomenclature for Isotopic Compounds

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Shell Development Company, Emeryville, California

THE RAPIDLY INCREASING AVAILABILty of isotopes of the common elements, both iradioactive and stable, makes it a certainty that research studies will soon involve the synthesis and utilization of many compounds containing abnormal concentrations of isotopes, usually in definite positions in the molecules. At the present time there is no general system of nomenclature for such compounds (with the exception of those containing deuterium), and therefore they are identified by structural formulas and by textual description.

Deuterium compounds are named in this country by the modified Boughton system, this convention having been established by the American Chemical Society in cooperation with representatives of the American Physical Society (E. J. Crane. *Science*, July 27, 1934, pp. 86–89). Under this system of nomenclature the position and number of deuterium atoms in the molecule are indicated in the name itself by the suffix $-m,n,\ldots-d_r$, where m and n are the positional numbers of deuterium atoms in the molecule or portion of the molecule and r is the number of deuterium atoms per molecule.

Several considerations seem pertinent concerning the establishment of a general system of nomenclature for isotopic compounds:

(1) The system of nomenclature should be applicable to all isotopes.

(2) For indexing purposes, as well as for clarity and convenience, the name of the isotopic compound should be very similar to that of the normal one.

(3) The position or positions in the molecule of the isotopes present in abnormal concentration should be indicated.

(4) Compounds containing isotopes in any abnormal concentration should be named by this system, rather than only those containing isotopes in essentially 100 per cent concentration, since for tracer purposes radioactive isotopes or stable isotopes in relatively small concentrations may be used.

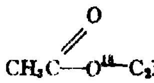
The importance of point 4 is considerable. It is unlikely that isotopes other then deuterium will soon be available in high purity. Moreover, the ratios of isotopic masses of other elements are much smaller than the ratio of those of hydrogen. Any differences in physical properties or chemical reactivity between normal compounds and those containing pure isotopes of other elements would therefore be much less marked than the differences obtainable with hydrogen isotopes. As a consequence, interest in pure isotopes other than deuterium should be small. Yet the synthesis and use of isotopic compounds involve very specialized problems whether the compounds contain an isotope in 100 per cent purity or not, and convenient reference and indexing in all such cases will be important.

These ideas were probably considered by the American Chemical Society Committee on Nomenclature, Spelling, and Pronunciation, for in its report on nomenclature of deuterium compounds (E. J. Crane. *Ind. eng. Chem.* (News ed.) 1935, **13**, 200) this statement is made: "If compounds of tritium are eventually made, they can readily be named in like manner, 't' being used as is 'd' in the Boughton names for deuterium compounds." Obviously, it is not inferred that such compounds would contain 100 per cent tritium atoms at a particular position in the molecule. It would seem entirely practical to name a compound to indicate abnormal isotopic concentrations and to specify the isotopic purity in the text in the same way that purities of ordinary chemical compounds are given.

As a beginning for consideration of the establishment of a general system of nomenclature for isotopic compounds, it is suggested that the system for deuterium compounds now in use in the United States be extended by using the suffix $-m,n,\ldots-i_r^p$, where m and n are the positional numbers or Greek letters commonly used for indicating the locations of substituents (in this case used to indicate the positions of an isotope in the molecular skeleton), i is the element symbol in lower case letters[1] of the isotope in abnormal concentration, p is the mass number, and r is the number of atoms in the molecule containing abnormal concentrations of the isotope i^p. As with deuterium compounds, it may be necessary for clarity to follow names of atomic groupings (methyl, ethoxy, etc.) with the proposed suffix. A few examples of this system of nomenclature are shown in Table 1.

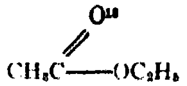
It will be seen that, in general, when the Geneva system of nomenclature applies, this system is applicable also. There are a few exceptions, such as the following:

$$C_6H_5N{=}N^{15}{-}C_6H_4Br$$



$$CH_3\overset{O}{\overset{/\!/}{C}}-O^{18}-C_2H_5$$

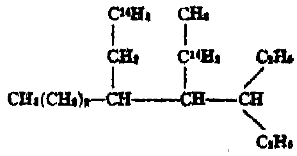
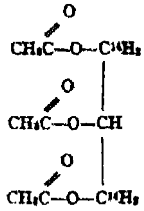
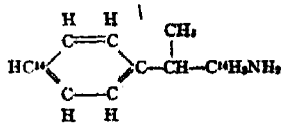
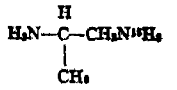
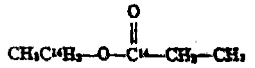
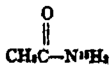
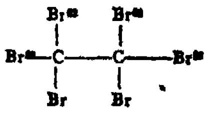
where one of two atoms of an element in a functional group is isotopic and the functional group is ordinarily expressed as a whole. These situations could perhaps be solved by extending the accepted system of nomenclature in some degree. For instance, the azo compound might be referred to as p-(phenylazo-α-n¹⁵)-bromobenzene and the ester as a ketone, methyl ethoxy-o¹⁸ ketone, hence



$$CH_3\overset{O^{18}}{\overset{/\!/}{C}}-OC_2H_5$$

would be methyl ethoxy ketone-o¹⁸. However both of these instances, and particularly the second, involve fundamental departures from, or extensions of, the present nomenclature and are presented here only to demonstrate that solutions to such problems can doubtless be found.

TABLE 1
EXAMPLES OF NAMES OF ISOTOPIC COMPOUNDS

2-butene-1-c¹⁴	$CH_3-CH{=}CH-C^{14}H_3$
2-propen-1-c¹⁴-1-ol	$CH_2{=}CH-C^{14}H_2OH$
3-ethyl-4-(ethyl-α-c¹⁴)-5-(ethyl-β-c¹⁴)-octane	
1,2,3-triacetoxypropane-1,3-c¹⁴	
β-phenyl-4-c¹⁴-propyl-α-c¹⁴-amine	
hexadecanoic-6-c¹⁴ acid	$CH_3(CH_2)_9C^{14}H_2(CH_2)_4COOH$
ethanoic-2-c¹³ acid (acetic-α-c¹³ acid)	$C^{13}H_3COOH$
1,2-propanediamine-1-n¹⁵	 $H_2N-\overset{H}{\underset{CH_3}{C}}-CH_2N^{15}H_2$
ethyl-α-c¹⁴ propanoate-1-c¹⁴	 $CH_3C^{14}H_2-O-\overset{O}{\overset{\|}{C^{14}}}-CH_2-CH_3$
acetamide-n¹⁵	 $CH_3\overset{O}{\overset{\|}{C}}-N^{15}H_2$
hexabromoethane-1,1,2,2-br$_4^{82}$	

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1. The sixth compound above was recently referred to by long descriptive name: "hexadecanoic acid labeled at carbon atom six with carbon fourteen" (William G. Dauben. Abstracts, Atlantic City Meeting, American Chemical Society, April 1947, p. 5M).

2. The seventh compound above was recently referred to as "acetic acid containing isotopic carbon in the methyl group" (H. S. Anker. *J. Biol. Chem.*, 1946, 166, 219).

3. The same principle could be applied to the new Dyson system of notation (G. Malcolm Dyson. Lecture, Royal Institute of Chemistry, London, 1946) for organic compounds, *i.e.* the isotope notation would immediately follow the "operation" which first refers to the atom or atoms in question. From our limited knowledge of the Dyson system it would appear that the use of a colon to set off the desired symbols is feasible. Thus, the third example above would be C8.3,4,5C2:11,14C14, the seventh would be C2:2C13,X, and the last would be C2.1,1,1,2,2,2BR:1,1,2,2BR82.

[1] Although the use of lower-case letters is consistent with the deuterium system of nomenclature, there is doubt in the minds of the authors as to whether the symbols of other elements should likewise be in lower-case letters, since this represents a more abrupt departure from convention. Also, confusion may result when lithium, lanthanum, or lutecium are involved, since a lower-case "l" may be confused with the numeral "1". However, this very departure may serve to draw attention to the fact that a special nomenclature is being used.

On the other hand, if a compound is generally referred to by a common name and cannot be conveniently characterized by the Geneva system, the use of the suggested nomenclature becomes simple only when the atoms of a particular element are isotopic in all positions of that element in the molecule. This situation will undoubtedly be frequent; some examples are: tyrosine-n^{15}, thyroxine-i_4^{131}, cystine-s_2^{35}, ergosterol-o^{18}, fructose 1,6-diphosphate-p_2^{32}.

It is hoped that these ideas will initiate further studies on this nomenclature problem so that publications in the near future which are concerned with isotopic compounds may be indexed conveniently and consistently.

NEWS *and Notes*

The fires which swept through Bar Harbor, Maine, this past week totally destroyed the Roscoe B. Jackson Memorial Laboratory for Cancer Research. C. C. Little, director of the Laboratory, reported to *Science* that the replacement value of the buildings, library, equipment, and mice is approximately $500,000. Little of this was covered by insurance. In addition to destruction of the Laboratory itself, the staff suffered almost complete loss of personal property. The summer student colony equipment was likewise consumed by the fire. An ABC announcement on Sunday, October 26, stated that the Damon Runyon Memorial Fund for Cancer Research is giving $50,000 immediately toward reconstruction work. Dr. Little indicated that less than 100 of the pedigreed mice were saved and that these are in scattered strains which cannot be identified. Because of exposure to fire and heat, those rescued are in very poor condition.

The staff is already making plans for renewing its work. Scientists everywhere may assist in rebuilding the library by sending pertinent reprints in the fields of genetics, embryology, cancer research, and experimental biology and medicine, and by advising the Laboratory about strains of mice from which extra litters are available for beginning the breeding work.

The Nobel Prize in Medicine was awarded jointly on October 23 to Carl F. Cori and his wife, Gerty T. Cori, of Washington University, St. Louis, and to Bernardo A. Houssay, of the Instituto de Biología y Medicina Experimental, Buenos Aires. The Coris, who received the Prize for their discovery of the "mechanism of enzymatic synthesis of glycogen, or animal starch" through the isolation of the enzyme, phosphorylase, are the third husband-wife team to be so honored, having been preceded by Pierre and Marie Curie (physics) and Frederick and Irene Curie Joliot (chemistry). Dr. Houssay, a diabetes specialist, who will receive half the Prize ($24,460.50), was honored for his "discovery of the significance of the hormone produced by the frontal lobe of the hypophysis."

AAAS–UNESCO Fellowships

These are anxious days for scientists. These are worried days for everybody who thinks about the future. The membership of the AAAS, the readers of this journal, know that everything possible should be done to maintain international peace and stability. Europe's economic distress, our own jittery struggle with prices and wages, our growing suspicions of Europe's policies and plans, and the feeling, in once friendly Europe, against "comfortable America" are bad, but still they are trivial compared with the social upheavals that would be inevitable throughout the world if a new bombing and poisoning war should build up out of international ill will and misunderstanding.

What can we do? We can work for international good will and tolerant understanding. Every group that has examined the situation reports that the liberal exchange of key personnel among the nations is one of the surest ways of attaining the goal. And scientific exchanges must rank high, because the scientist is so readily and naturally international and peacefully cooperative. The United Nations, UNESCO, the National Research Council's UNESCO Committee, the various associations of scientific workers, and many other groups are on record as to the high importance of scientific interchanges. Traveling politicians are frequently viewed with alarm; traveling merchants may be suspected of working for special interests rather than for the world at large. Scientists, scholars, and artists, however, are relatively clear of suspicion; they are heartily welcomed nearly everywhere.

I am inviting you to help in arranging for some important exchanges. We know that hundreds of advanced students of science in Europe, Asia, and elsewhere are at this moment desirous of continuing their specialized training at the educational institutions of other countries, especially America. Unfavorable monetary exchanges, high traveling costs, and the high price of living in America have made it impossible for most of these gifted students to carry through a plan that should serve science, serve their native countries, and promote international understanding.

At a recent meeting, the Executive Committee of the AAAS endorsed enthusiastically the proposal of its newly formed Subcommittee on International Relations that funds be raised to provide special international fellowships for the next two or three years, to be administered with the assistance of UNESCO and to be known as AAAS-UNESCO Fellowships.

Our Association does not have accumulated resources that can be used for such fellowships. I am authorized to appeal to the membership of the Association, and to the readers of this journal, for contributions for the establishment of the Fund. Although I would not want to discourage large contributions (in fact, many will be necessary), it will be most satisfactory if the major support of the AAAS-UNESCO Fund comes from a very large number of Americans; a wide response would be in the democratic spirit. Small contributions are therefore in order. Please give all you can, and get some of your acquaintances, who are also sensitive to the situation confronting civilization, to give even more.

It is our expectation that in some instances the universities and colleges receiving AAAS-UNESCO Fellows will cancel tuition charges; and for some the home governments can assist with traveling expenses. But at least $2,000 should be available for each Fellow. You can count on competent operation of the fund by those who are experienced in the handling of traveling fellowships.

HARLOW SHAPLEY

President, and *Chairman, International Relations Committee, AAAS*

[Checks should be made out to AAAS-UNESCO Fellowship Fund and sent to 1515 Massachusetts Avenue, N.W., Washington 5, D. C.]

About People

Chalmer J. Roy, associate professor of geology, and director, Geology Summer Camp, Louisiana State University, has been appointed chairman of the Department of Geology, Iowa State College.

George Katona has been appointed associate professor of psychology at the University of Michigan, where he is directing the Federal Reserve Study for the Survey Research Center.

Jack O. Purdue, Princeton University, has been appointed instructor in chemistry and physics at Oklahoma Baptist University, and **Irma R. Fulhage,** Iowa State College, has been appointed instructor in biology.

Colleges and Universities

The Institute of Optics, University of Rochester, has developed a motion-picture camera capable of taking up to 11,000,000 frames per second. The camera, nominally rated at 5,000,000 frames per second, is believed to be more than 10 times faster than any other previous model. **Brian O'Brien,** research professor of physics and optics and director of the Institute, explained at a meeting of the Society of Motion Picture Engineers on October 21 in New York that the new camera will make hitherto impossible photographic studies quite easy to carry out, such as the investigation of electrical discharges, high explosives, shock fronts, and very rapid motion in jets and projectiles. Dr. O'Brien further pointed out that although the camera is very valuable for scientific investigations, it is not suitable for ordinary pictures, because the methods used to get the excessively high speed greatly limit the quality of the pictures. The 50-pound portable camera was developed by Dr. O'Brien and **Gordon G. Milne,** research associate in optics at the Institute.

The new 80-room laboratory which will house the Fels Research Institute for the Study of Human Development at Antioch College, Yellow Springs, Ohio, was dedicated on October 17, at which time the cornerstone was laid by Samuel S. Fels, who made the initial gift establishing the Institute 18 years ago. The new building will include laboratories for biochemical, physiological, genetic, and anthropological research, an experimental nursery school, and psychological testing rooms. The principal speaker on the occasion was Margaret Mead, associate curator of Ethnology at the Museum of Natural History, New York City.

The atmosphere of Mars, the only other planet having conditions favorable for life as we know it, has been found to contain about the same amount of carbon dioxide as does the atmosphere on earth. **Gerard P. Kuiper,** director, Yerkes and McDonald Observatories of the Universities of Chicago and Texas, has recently measured the percentage of carbon dioxide in the Martian atmosphere with his self-designed infrared spectrometer, which photographed two new carbon dioxide bands. Poisonous gases, such as methane and ammonia, are absent on Mars, according to Dr. Kuiper, but the bulk of the atmosphere may be made up of nitrogen, which does not have bands in the observable part of the spectrum. Dr. Kuiper pointed out that the Martian polar caps are probably ordinary snow and clouds, made of water. Further study with the spectrometer will be made of the polar cap on February 17, when Mars is at opposition and near aphelion, its distance from the earth then being about 61,000,000 miles, and its distance from the sun being about 154,633,000 miles. If the polar cap at that time appears large enough for spectral observation, it will at last be possible to measure the amount of water present. The absence of oceans has already indicated that the total quantity of water on the planet must be small, and the lack of water seems further confirmed to some astronomers, such as Lowell, who believe the "canals" to be strips of vegetation cultivated along the sides of artificial lines of irrigation which have been built by intelligent beings in order to make the best use of the limited water supply. Dr. Kuiper also expects to study these dark areas on Mars for the possibility of such vegetation.

The infrared spectrometer, 1,000 times more powerful than any previous instrument, the electrical parts of which were constructed by **R. J. Cushmand** and **Wallace Wilson,** physicists at Northwestern University, was first attached to the 82-inch reflector at McDonald Observatory in December 1946 and has been in constant operation ever since. It has already discovered 7 enormously strong absorption bands due to carbon dioxide near 1.6 and 2.1 μ in the Venus spectrum and has also recorded the spectra of Mercury, Saturn, and many stars.

The University of Wisconsin has introduced into its curriculum a number of history of science courses, intended to give the average college graduate, and those in the fields of pharmacy and medicine, an understanding of the position of science in contemporary society. Toward this end, four men have been appointed to new professorships in this field. **Marshall Clagett,** formerly of Columbia University, and **Robert C. Stauffer,** who also conducts a seminar in Darwinism, are teaching the history of science. **George Urdang,** professor, School of Pharmacy at Wisconsin, and director, American Institute of the History of Pharmacy, will teach the history of pharmacy, and **Erwin H. Ackernecht,** formerly assistant curator of Anthropology, American Museum of Natural History, will be professor of the history of medicine.

Meetings

The American Society for the Study of Arteriosclerosis will hold its second meeting on November 2–3 at the Hotel Knickerbocker, Chicago. The program has been divided into four sessions dealing, respectively, with Anatomic, Physiologic, Metabolic, and Therapeutic Considerations in the Study of Arteriosclerosis. Each session will be concluded with a round table, general discussion, and summary by the session chairman.

International Biometric Society Formed at Woods Hole Conference

A new international organization, the Biometric Society, was formed at the First International Biometric Conference held at the Marine Biological Laboratory in Woods Hole, Massachusetts, on September 5–6. The Woods Hole conference was attended by 100 biologists, statisticians, and other mathematicians from the United States and abroad. The Biometric Society will be concerned with the advancement of quantitative biological science through the development of quantitative theories and the application, development, and dissemination of effective mathematical and statistical techniques. Its officers are R. A. Fisher, Cambridge University, president; J. W. Hopkins, National Research Council (Ottawa), treasurer; and C. I. Bliss, Connecticut Agricultural Experiment Station, secretary. As of September 6 the other members of the Council are: Maurice Belz, University of Melbourne; R. C. Bose, Calcutta University; Detlev W. Bronk, National Research Council (Washington); Gertrude M. Cox, University of North Carolina; Carlos Dieulefait, National University of the Litoral (Rosario, Argentina); J. B. S. Haldane, University of London; A. Linder, University of Geneva; M. G. Neurdenburg, Municipal Medical and Public Health Service (Amsterdam); G. Rasch, State Serum Institute (Copenhagen); Georges Teissier, Centre National de la Recherche Scientifique (Paris); J. W. Tukey, Princeton University; and E. B. Wilson, Harvard University. Additional Council members will be announced later.

A draft constitution for the new Society was drawn up by a committee of 12 representing 10 different countries. After considering possible forms of international cooperation in biometrics, the committee decided in favor of an individual membership society without national quotas. Following a short address on international cooperation in science by Dr. Bronk at the Saturday morning session, the committee's recommendation and the draft constitution were presented to the Conference with Dr. Dieulefait as chairman. The Conference adopted the recommendation and under the chairmanship of Prof. Belz debated the draft constitution article by article. It then voted to form the Biometric Society as an international organization devoted to the mathematical and statistical aspects of biology with those present, or invited and unable to attend, as charter members. The committee which drafted the constitution was elected as the first Council with power to add others to its membership.

The Conference opened with a welcome to the Marine Biological Laboratory by Charles L. Packard, director. The Conference elected Profs. Teissier, Fisher, and Bliss as chairman, co-chairman, and secretary, respectively. Following the business session, A. F. Blakeslee, of Smith College, took the chair for a session on quantitative genetics. The principal paper, on "A Quantitative Theory of Genetic Recombination," was by Prof. Fisher with discussion opened by D. G. Catcheside, also of Cambridge University. The Friday afternoon session, under the chairmanship of Prof. Wilson, consisted of reports on recent biometric developments overseas by Drs. Rasch, Bose, and others. The scientific part of the Conference was concluded on Saturday afternoon under the chairmanship of L. F. Nims, of the Brookhaven Laboratories, with an address by Dr. Teissier on "La Relation D'Allometrie, sa Signification Statistique et sa Logique." A summary was translated by J. Monod, of the Institut Pasteur, Paris, who opened the discussion.

The proceedings of the Woods Hole conference will be published in the December issue of *Biometrics*, a copy of which will be mailed to each charter member who is not receiving the journal through membership in the Biometrics Section of the American Statistical Association.

The Biometric Society welcomes to membership biologists, mathematicians, statisticians, and others interested in its objectives. By later action of the Council charter membership is extended to all who join the Society before February 1, 1948. Further information can be obtained from the secretary, C. I. Bliss, Box 1106, New Haven 4, Connecticut, U. S. A.

Elections

At the 93rd convention of the American Pharmaceutical Association, held in the 95th year of its history at Hotel Schroeder, Milwaukee, Wisconsin, August 24–30, with more than 1,200 persons present, the following officers were elected by the House of Delegates, legislative body of the Association: Gustavus A. Pfeiffer, director, William R. Warner & Company, honorary president; Hugo H. Schaefer, Brooklyn, New York, treasurer; and Robert P. Fischelis, Washington, D. C., secretary. Other officers elected by mail ballot of the membership were Sylvester H. Dretzka, of Milwaukee, incoming president; Augustus J. Affleck, Sacramento, California, first vice-president; and Roy L. Sanford, Enid, Oklahoma, second vice-president.

Tau Beta Pi, national engineering honorary society, held its 42nd convention at the Hotel New Yorker, New York City, October 9–11. Undergraduate delegates from 76 U. S. engineering schools attended the meeting. On the evening of October 9, 7 outstanding students at Stevens Institute of Technology and the following 10 engineers from the New York area were initiated into the society: Robert M. Burns, Bell Telephone Laboratories; Stanley Bracken, Western Electric Company; Edmund A. Prentis, Spencer, White and Prentis, Inc.; Harold S. Osborne and Keith S. McHugh, both of the American Telephone & Telegraph Company; John W. Marden, Westinghouse Electric Corporation; Carl Whitmore, New York Telephone Company; Hudson R. Searing, Consolidated Edison Company of New York; Robert M. Gates, Air Preheater Corporation; and Charles E. Wilson, General Electric Company.

The society, which was founded at Lehigh University in 1885, now has 79 undergraduate chapters in engineering schools, 26 alumnus chapters, and over 48,400 members. The new officers (as of December 1947) are: Merton M. Cory, president; E. R. Moore, vice-president; and Harvey M. Merker, R. H. McCarroll, and Lawrence W. Lentz, councilors.

Recent Deaths

William M. Sylvis, 65, professor of surgery, Hahnemann Hospital, and formerly professor of anatomy, Hahnemann Medical College, Philadelphia, died October 1 at his home in Philadelphia.

Clarence H. Smith, 72, consulting otolaryngologist, Morisania City Hospital, and consulting otologist, Manhattan Eye and Ear Hospital, died October 6 at his home in the Bronx.

William D. Ennis, 70, professor emeritus of economics of engineering, Stevens Institute of Technology, Hoboken, New Jersey, died October 14 of a heart ailment at Good Samaritan Hospital, Suffern, New York.

Francis C. Krauskopf, 69, professor of chemistry, University of Wisconsin, and a member of Wisconsin's Department of Chemistry since 1903, died of a heart attack October 16 at his home in Madison.

Francis Ernest Lloyd, 79, professor emeritus of botany and retired chairman, Department of Botany, McGill University, died October 17 in Carmel, California.

George H. Peters, 84, astronomical photographer, U. S. Naval Observatory, Washington, D. C., died in Washington October 18. Mr. Peters was known for his photographs of the solar corona, of sunspots, and of minor planets.

Sir Albert Howard, 73, agricultural scientist, former director of the Institute of Plant Industry, Indore, and agricultural adviser to states in Central India and Rajputana, died October 20 at his home in London.

Herbert Raymond Moody, 77, professor emeritus of chemistry and director of the Chemistry Laboratories, College of the City of New York, from 1905 until his retirement in 1938, died October 20 at his home in Vienna, Virginia.

The wing beat of the common drone fly may now be witnessed at a special exhibit at the American Museum of Natural History, sponsored by the Museum and the Sperry Gyroscope Company. Development of the animated enlarged scale model culminates a three-year research project during which it was necessary to use high-speed movie cameras in order to photograph the fly's wing beating 300 times per second. **C. H. Curran,** Museum entomologist and supervisor of the joint research project, pointed out that aircraft designers have been seeking the answers to the aerodynamics of insect flight, believing that the principles involved might be of practical use. In the study it was discovered that the halteres of the fly have a true gyroscopic action, but that they are not gyroscopes. A gyroscope produces balance by rotating, while the halteres produce balance by vibrating from side to side in an arc of 90°. They move opposite to the wings, moving downward when the wings rise and upward when the wings go down. **Chris E. Olsen,** Museum artist and preparator, constructed the model.

An Eye Laboratory has been established at St. Vincent's Hospital, Los Angeles, by the Estelle Doheny Eye Foundation to provide certain modern ophthalmic facilities badly needed in southern California. The Laboratory will serve as a pathological laboratory for the diagnosis and registration of pathological specimens, the preparation of slides, and the building up of a museum of eye pathology, and as a bacteriological laboratory where diagnostic scrapings, smears, and cultures may be studied, animal inoculations made, and the sensitivity of organisms to various drugs and antibiotics determined. The Laboratory will also provide facilities for fundus, gross, and slitlamp photography, maintain a library of photographs and motion pictures for teaching ophthalmology, provide an eye bank for southern California, distribute and loan certain drugs and equipment not otherwise available, and make available special equipment for radiation therapy of the eye for use outside the laboratory. The advisory board will consist of Alan Woods, Johns Hopkins Medical School; Cecil O'Brien, University of Iowa; and Phillips Thygeson, University of California. A. Ray Irvine, University of Southern California, is chairman of the original board, and Peter Soudakoff, Peking Union Medical College, will serve as full-time pathologist at the Laboratory. The Foundation and Laboratory are made possible by the donation of Mrs. Edward Laurence Doheny.

The Atomic Energy Commission has recently appointed as the director of its Office of Public and Technical Information **Morse Salisbury,** formerly director of information, U. S. Department of Agriculture, and currently assistant secretary-general, International Emergency Food Council. The associate director will be **Edward R. Trapnell,** formerly public relations adviser to Major Gen. Groves, Commanding General, Manhattan District, and acting director of information, AEC; the chief of declassification, **Harold Fidler,** formerly assistant director of research, Oak Ridge; and the chief of technical information, **Alberto Thompson,** formerly director of the publication of technical information, Atomic Energy Project. The responsibility of the Office of Public and Technical Information is to screen all the material to be issued to the public concerning the Commission's activities and ascertain that all has been properly declassified and cleared with respect to restricted data as defined in the Atomic Energy Act. This work of declassification is being carried on by a consulting staff of over 100 scientists throughout the project. The "Declassification Guide" developed by the Manhattan District in accordance with recommendations of a committee headed by Richard C. Tolman, California Institute of Technology, sets forth the standards of the declassification process of the Office.

The U. S. Office of Education has reported that American colleges and universities need to almost double their existing classroom facilities. They now need an additional 90,000,000 square feet of classroom space and will need a total of 300,000,000 square feet by 1950. The Veteran's Educational Facilities Program Section of the Office of Education pointed out that this is a construction job comparable to building an entire business district for a large city. This fall's college enrollment has been estimated to be 2,750,000 students, 600,000 more than last fall. It has also been estimated that in 1951–1952, the enrollment will drop to 2,477,000, rising again to 2,924,000 in 1959–1960.

The General Disposals Division, Office of the Foreign Liquidation Commissioner, 4th and Jefferson Drive, S.W., Washington 25, D. C., is offering portions of two German chemical plants for sale to U. S. industry. These are the Dynamit A. G. Geestacht-Krummel plant, on the Elbe River about 19 miles southeast of Hamburg, its equipment consisting of 21 items used in the production of plastics with grinding mills, distilling vats, especially lined storage tanks, a crusher for artificial resins, and allied facilities; and the Paraxol at Lippoldsberg, including one producing unit for formaldehyde and two units for the production of pentarythritol. Also available to U. S. purchasers is the electrical generating equipment used with these units. Inventories of these plants and information concerning inspection and bids may be obtained from the General Disposals Division. December 10 is the closing date for sealed bids on both plants.

COMMENTS *by Readers*

One wishes that every scientist and engineer might read the memorandum which accompanied President Truman's veto of the recent National Science Bill, S.526, and the more recent pamphlet, *Science and public policy*, by John R. Steelman, chairman of the President's Scientific Research Board.

From the first comes an appreciation of the complications that necessarily inhere in attempting, as in S.1850 and again in S.526, to make a single organization responsible at once for the allocation of funds to support pure science and for the direction of military research.

The latter makes it abundantly clear that in the rapid growth of science the politician sees ample justification for giving it his increasingly close attention so that it may be properly assimilated into the national life. Repeatedly the report stresses the concept of planning and guiding research effort so as to coordinate it more closely with the scientific programs of the Federal bureaus and with military research as well as with the industrial needs of the Nation (see, e.g., passages on pp. 5, 6, 9, 26, 31, 34, and 61).

Thus, the combined effect of the veto memorandum and the Steelman report is most revealing.

Doubtless, the President stands on firm ground when he demands executive control of any government agency engaged in military research and development. This alone would have justified his veto, but he implies very pointedly that he vetoed S.526 because it failed to give him the broad control over scientific effort which he believes he should have. This is the minimum political price which must be paid if the foundation is created to discharge the dual purpose.

So why strive longer to domicile an antelope and a bear in the same pen? Why create the national fiction that the interests of pure science require intimate association with military research, or vice versa? I wish to imply nothing for or against the hypothecated need of a central organization for military research and development after the pattern of OSRD. This may be very desirable; but in proportion as it is desirable, it is certainly undesirable that it be yoked to the most international of all undertakings. To do this seems as confusing an approach to world relationships, scientific and otherwise, as it is an unpromising approach to the problem of supporting science here at home.

Given a clean-cut separation of these two functions that envisages a science foundation whose sole purpose is to allot funds for pure science, this foundation could receive Federal aid though it were quite unattached to the executive arm of the Government. Congress can and does continually appropriate money to organizations over which the President has no control.

Adopting such an arrangement for science, the resulting foundation might have a wholly private status, or it might be quasi-governmental after the pattern of the National Academy of Sciences. Some will recall that the Willis Bill before the 79th Congress proposed this latter arrangement. Its sponsors recognized the basic undesirability of associating military research with the allocation of considerable sums for the support of pure science, and feared also the additional threats to scientific freedom which must lie in any foundation subservient to the executive arm of the Government. But what in the minds of some of us is equally important, an extra-governmental agency closes no door upon whatever personal and corporation giving may again be stimulated, either by modification of income tax credits or otherwise.

We do not, however, regard the road leading to such an agency as strewn with violets. American science is to date inexperienced in the centralized partitioning and distribution of its lifeblood. The veto memorandum, in effect, declares that the problem cannot be solved without the intervention of political personnle and political authority; and though this is, perhaps, its one unhappy note, all must admit that the President's apprehension offers a constructive warning. He points out that members of the foundation, as envisaged in S.526, would be employees of institutions or organizations eligible for grants, and that out of the resulting conflict of interests and responsibilities, and regardless of their complete integrity, the members might be suspected of favoritism. But the course he proposes of taking control away from the scientific members and giving it to political appointees will be regarded by many as epitomizing the dangers most to be feared. Fortunately, alternatives are at hand.

There is, for example, the representative type of institution, operated within the compass of science itself. After all, broad representation is the traditional American way and protects to a degree which is probably unattainable otherwise.

This solution might be approached through a sort of constitutional convention, whose deliberations so far as American science is concerned would promise to rank in significance with those epochal sessions held in Philadelphia a century and a half ago. The aim of this science convention would be to formulate and agree upon a representative central fiscal agency. This would be embodied in a constitution and a system of elections for officers and members such as to merit the approval of both the scientific fraternity and leaders of public opinion. As to the desired safeguards and flexibility of such an agency, these have been emphasized so often in the course of the debates on science legislation that they need only be summarized in a word or two here. Chiefly, they would insure that the allocations of research money would be widespread geographically, they would insure the recognition of scientific merit and promise wherever these might arise, and they would shoulder few, if any, encumbrances upon the recipient. (ROBERT W. KING, *463 West Street, New York City.*)

* * *

The present communication deals with almost forgotten material on the dental aspects of prenatal injury. Preparation of a bibliography on the effects of German measles during pregnancy recalled to the writers a concept, commonly taught in dental schools in this country, to the effect that acute infectious diseases in the mother during pregnancy will cause congenital anomalies of the deciduous dentition in the infant, if these diseases occur during the time when the teeth are forming. It is also understood that these same diseases in infants and young children, occurring during the period when the permanent teeth are forming, will similarly affect these teeth.

A partial study of the available dental literature on this subject has revealed an interesting discussion which includes the presentation of a case similar to those found by Evans (*Med. J. Aust.*, 1944, **2**, 225). This was reported in 1893 by J. J. R. Patrick as follows (*Dent. Rev.*, 1893, **7**, 439):

"I have entered thus far into a description of the origin and development of the teeth, in order to illustrate the detrimental influence of eruptive fever on the teeth during the periods of their formation; and while eruptive fevers are not the only factors to be recognized in producing abnormal conditions in tooth development, I consider such fevers a prolific source of faulty nutrition in these organs, as the following cases observed in my practice will fully exemplify.

"Mrs. S., during the fifth month of gestation was afflicted with scarlet fever—recovering, in the course of time gave birth to a child. This child's teeth appeared unusually early, the enamel discolored, pitted and granular and absent at the incisive margins, and the teeth barely extended beyond the gum. He is now fifteen years old with all his permanent teeth except the third molars. These second teeth, with the exception of a little decay, are in good condition, the enamel smooth and white and all the teeth large and strong.

"Three years later another child was born, and soon afterward the first child contracted the measles and the second child also contracted the disease. In the course of time the deciduous teeth of the second child appeared, all in excellent condition, but were lost unusually early, and the second set appeared in the following order: The sixth year molars at four years. The central incisor at five years. The premolars between the sixth and seventh years; and the cuspids between the eighth and ninth years. All these teeth are discolored, pitted and granular, and the enamel is worthless as a protection to the dentine."

Later in the same year Dr. Patrick attended the World's Columbian Dental Congress at Chicago, where a paper on the pathology of congenital defects of the deciduous dentition was presented by Otto Zsigmondy. During the discussion of this paper Dr. Patrick made the following remark (*Trans. World's Columbian dent. Congr.*, 1894, **1**, 65):

"All eruptive diseases during gestation must necessarily affect the enamel of the deciduous teeth if these eruptive diseases take place during the formative process of the enamel. How could it be otherwise?"

The quotations given above not only show that Dr. Patrick had developed a clear concept of the role of acute disease of the mother in the causation of congenital defects of the infant in the field of dental development, but also point out two factors which are of importance in the current efforts to clarify the medical aspects of this problem. The teeth are relatively permanent structures, and their embryology has been worked out in considerable detail. It is therefore apparent that the presence or absence of defects in the deciduous teeth will be of great importance in the evaluation of the effects of various disturbances of pregnancy on the fetus during the period of tooth formation. A study of the simultaneous occurrence of dental defects and malformations in other organs will also be of considerable interest.

Dr. Patrick's second case points out that the problem of developmental anomalies is not limited to the period of gestation, but also extends for some time beyond the birth of the child. This postnatal aspect of the problem deserves more study from a medical point of view. The importance of the presence or absence of dental defects, especially in conjunction with defects in other parts of the body, is again apparent. (R. J. M. Horton, *Harvard School of Public Health*, and J. M. Dunning, *Harvard School of Dental Medicine*.)

* * *

To express in a mathematical formula a complicated physiological response such as that involved in body-temperature reactions of cattle to climate, the fundamental requirement is that it be based on as complete an accumulation of facts as possible. To modify a formula that satisfies this condition by introducing a factor based on an assumption unsupported by experimental evidence is to confuse rather than to advance the knowledge of the subject.

In a recent paper R. F. Gaalaas (*J. dairy Sci.*, 1947, **30**, 79–85) has modified the formula

$$HT = 100 - [10(BT - 101.0)]$$

originated by Rhoad (*J. animal Sci.*, 1942, **1**, 85) to

$$HT = 100 - [14(BT - 101.0)].$$

In the Rhoad formula the factor 10 is used merely to remove the decimal from the result within the parentheses. In this manner a whole-number coefficient in a scale of 100 is obtained, with 100 equal to perfect efficiency in maintaining a normal body temperature of 101.0°F., under prescribed rules of a test procedure (A. O. Rhoad. *Trop. Agric.*, 1944, **21**, 162–164).

The factor 10 was changed by Gaalaas (p. 80) "based on the assumption that a body temperature of 108°+ at 90°F. air temperature and under otherwise normal conditions would indicate a complete loss of control in the regulation of body temperature, or zero per cent efficiency in eliminating surplus body heat. Conversely, a body temperature of 101°F. is considered normal and a cow that would maintain that body temperature at 90°F. air temperature would be considered 100 per cent efficient. . . ."

The reader is led to believe that the factor 14 was derived by dividing the 7° range between 101 and 108 into 100 equal parts, thereby placing a value of 0.14285716 . . . ∞ on each tenth of a degree on the clinical thermometer.

In correspondence, Gaalaas states that the factor 14 is a correction factor necessary because his cows had "access to shade instead of requiring them to be held in the sun. . . . The factor 14 is enough larger to correct for the observed average difference in body temperatures." A check on the results published earlier by Gaalaas (*J. dairy Sci.*, 1945, **28**, 555–563) gives credence to this interpretation of the origin of the factor 14 and is acceptable as a correction factor, as it is properly supported by satisfactory data.

One wonders, therefore, why an unsupported assumption is given as the base for changing the factor 10 to 14 in the original formula! (Albert O. Rhoad, *Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.*)

* * *

TECHNICAL PAPERS

Chloromycetin, a New Antibiotic From a Soil Actinomycete

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The Research Laboratories, Parke, Davis & Company, Detroit
Paul R. Burkholder
Osborn Botanical Laboratory, Yale University

Fom a soil sample collected in a mulched field near Caracas, Venezuela, a *Streptomyces* sp. was isolated.[1] Agar streak cultures were found to inhibit adjacent inocula of *Bacillus mycoides*,[1] *B. subtilis*,[1] *Mycobacterium tuberculosis* var. *hominis* (ATCC 607[1] and H37Rv[2]), *Staphylococcus aureus*,[1,3] *Streptococcus pyogenes*,[3] *Brucella abortus*,[3] *Escherichia coli*,[1,3] *Klebsiella pneumoniae*,[3] *Salmonella schottmuelleri*,[3] and *Shigella paradysenteriae* (Sonne).[3] When the organism was grown in liquid media in shaken flasks, filtrates of these submerged aerated cultures proved to possess marked antibacterial activity in broth-dilution assays against several gram-negative bacteria, notably *S. paradysenteriae* (Sonne), and indications of antirickettsial activity. From these filtrates a crystalline antibiotic has been isolated, for which the name Chloromycetin is proposed.

TABLE 1

Vol. medium	Container (capacity)	Yield (μg./ml.)
100 ml.	Erlenmeyer flask (500 ml.)	55
18 l.	Glass fermenter (30 l.)	85
100 gal.	Rotary aluminum drum (200 gal.)	49

The organism has been found to produce Chloromycetin in aerated submerged culture in various media. A satisfactory formula is: maltose, 1.0 per cent; casamino acids (Bacto), 0.5 per cent; distillers' solubles, 0.5 per cent; and sodium chloride, 0.5 per cent. Typical yields with this medium in various containers are given in Table 1. Potency is estimated turbidimetrically in terms of weight of crystalline material from a standard curve for 50 per cent inhibition of *S. paradysenteriae* (Sonne).

It was found that Chloromycetin could be concentrated and purified by extracting acidified culture filtrates with ethyl acetate, removing the solvent by distillation *in vacuo*, extracting the antibiotic with diethyl ether, chromatographing the ether solution over aluminum oxide, removing the solvent by evaporation, extracting the residue with water, extracting the aqueous solution with petroleum ether, and concentrating the aqueous solution. During the course of the concentration the antibiotic crystallized. After three recrystallizations from methylene dichloride, ethylene dichloride, and a mixture of diethyl ether and petroleum ether, colorless needles or elongated plates having the following properties were obtained: m.p., 149.7–150.7°C. (corrected); $(\alpha)_D^{25}$, − 25.5° (ethyl acetate)[4]; solubility in water at 25°C., about 2.5 mg./ml.; very soluble in methanol, ethanol, butanol, propylene glycol, and acetone; analysis: C, 41.11; H, 3.89; N, 8.60; Cl (nonionic), 21.71.[5]

Chloromycetin is a neutral compound and is unique in that it contains both nitrogen and nonionic chlorine. It is furthermore characterized by being stable at room temperature in aqueous solutions over the pH range of 2–9 for more than 24 hours, and in distilled water is unaffected by boiling for 5 hours.

The *in vitro* activity of the crystalline material against several bacteria is shown in Table 2. The test against *Br. abortus* was performed by dissolving varying amounts of the crystals in agar and streaking with *Br. abortus*.[3] *Myco. tuberculosis* was assayed by an end-point broth-dilution method.[2] The other organisms were tested by a turbidimetric method.[3]

TABLE 2

Weight of Crystalline Chloromycetin Causing Inhibition of Test Organism

Species	μg./ml.	Inhibition (%)
Brucella abortus	2.0	100
Escherichia coli	0.33	50
Klebsiella pneumoniae	0.33	50
Mycobacterium tuberculosis (H37Rv)	12.5	100
Proteus sp.	0.33	50
Salmonella schottmuelleri	0.33	80
Shigella paradysenteriae (Sonne)	0.2	50
Staphylococcus aureus	1.0	50

The crystalline material showed marked chemotherapeutic activity against *Rickettsia prowazeki* in screening tests using chick embryos[6] and against a number of rickettsiae and one virus when tested in embryonated eggs or in mice (*1*).

The intravenous LD$_{50}$ for 20-gram mice is 3.0 mg./mouse. In contrast to streptomycin, Chloromycetin appears to be well absorbed when administered orally to mice and dogs.[7]

Detailed accounts of these studies are in preparation.

Reference

1. Smadel, J. E., and Jackson, E. B. *Science*, 1947, **106**, 418.

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[1] In Paul R. Burkholder's laboratory, Yale University.

[2] In Guy P. Youmans' laboratory, Northwestern University.

[3] In the Research Laboratories, Parke, Davis & Company.

[4] Determined by Robert L. Harris, Parke, Davis & Company.

[5] Determined by A. W. Spang, Parke, Davis & Company.

[6] Determined by I. W. McLean, Jr., Parke, Davis & Company.

[7] Determined by O. M. Gruhzit, Parke, Davis & Company.

Chloromycetin, an Antibiotic With Chemotherapeutic Activity in Experimental Rickettsial and Viral Infections

J. E. Smadel and E. B. Jackson

Department of Virus and Rickettsial Diseases,
Army Medical Department Research and Graduate School,
Army Medical Center, Washington, D. C.

A new antibiotic, Chloromycetin (*1*), has been found to have a remarkable chemotherapeutic effect on a number of rickettsial agents and on one of the viruses. This substance was prepared in the Research Laboratories of Parke, Davis & Company and submitted to this Department as highly purified crystalline material; preliminary tests (*1*) had indicated that Chloromycetin possessed activity against *Rickettsia prowazeki*.

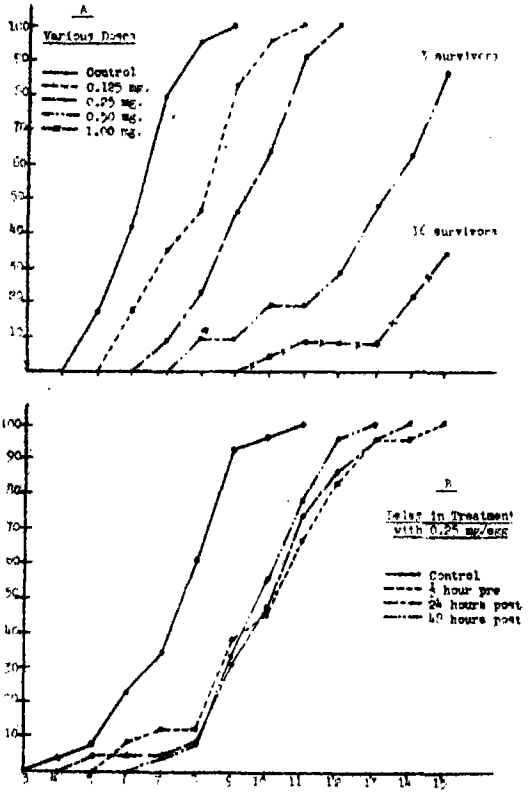

FIG. 1. Rickettsiostatic effect of drug in embryonated eggs infected with *R. orientalis*.

Initial tests were performed using groups of 24 seven-day embryonated eggs which were infected by the yolk sac route with the Gilliam strain of *R. orientalis* and treated by the same route with varying amounts of drug given at different times. Eggs were examined daily and the time of death of embryos noted. Data are summarized in Fig. 1 as the percentage mortality in the various groups on different days after infection. The experiment summarized in A, Fig. 1, shows the effect of varying amounts of drug given in a single injection ½ hour prior to infection. It is evident that the smallest dose used, namely, 0.125 mg./egg, resulted in a definite prolongation of life of the embryos. The beneficial effect increased step by step as the dose was increased. All of the embryos in the group receiving 1.0 mg. were alive when the last of the control eggs died. Furthermore, 16 of the 24 embryos were still alive in this group on the 15th day after infection, when the experiment was terminated since hatching was to be expected. Eight chicks did hatch from this group of 16 survivors. Section B of Fig. 1 summarizes an experiment in which 0.25 mg. doses of drug were given to each of 24 eggs in three different groups; one group was treated ½ hour prior to infection, another 24 hours, and a third 48 hours, after infection. It is apparent that all embryos were equally benefited by the treatment; the average prolongation of life in each of the groups was in the neighborhood of 2½ days.

The chemotherapeutic effect observed in treated mice infected with scrub typhus was as satisfactory as that obtained in experiments with embryonated eggs. Table 1 summarizes the results of studies on mice infected by the intraperitoneal route with 25–100 m.l.d. of the Karp strain of *R. orientalis*.

TABLE 1

CHEMOTHERAPEUTIC EFFECT OBTAINED IN MICE INFECTED WITH *R. orientalis*

Experiment	Treatment			Dilution of infectious inoculum		
	Mg./day/mouse	Route	Day begun in relation to infection	10^{-5}	10^{-6}	10^{-7}
1	Controls	Injected intraperitoneally		8/8	8/8	2/7
	2.5		1 post	0/8		
	1.5		1 "	0/8		
	0.75		1 "	2/8		
	0.5		1 "	5/8		
	0.25		1 "	5/8		
	0.10		1 "	3/8		
	3.0	Fed in water	1 pre	0/8		
	5.0		2 post	1/8		
	3.0		1 pre	0/7		
	1.5		1 "	1/8		
2	Controls	Injected intraperitoneally		7/8	7/8	3/8
	2.5		1 post	0/8		
	2.5		5 "	0/8		
	2.5		8 "	1/8		
	2.5		10 "	3/8		
	0.75		1 "	2/8		
	0.75		5 "	2/8		
	0.75		8 "	6/8		
	0.75		10 "	7/8		

Animals were treated either by a single daily intraperitoneal injection or by oral administration of the designated amount of drug; in the latter instance it was dissolved in the drinking water. Animals were given their first injection 18 hours after infection or at a later date designated in the table. Mice which were fed the drug generally were started on it the day before inoculation of infectious material. In all instances mice were treated from the designated time through the 20th day after infection. The data indicate that a single daily intraperitoneal dose of 1.5 mg. of the drug protected all of the mice. Half this amount protected the majority, while doses as small as 0.1 mg./mouse had some chemotherapeutic effect. All of the mice which received 3.0 mg. of the drug by mouth per day survived, as did practically all of those receiving half this amount. It is to be noted that oral administration of 5.0 mg./day begun two days after infection protected 7 of the 8 mice from death. The fact that an excellent chemotherapeutic effect can be obtained even when administration of the drug is delayed for 10 days after infection is indicated by the results of the second experiment (Table 1). Seven of the 8 untreated control mice which received the 10^{-6} dilution of infectious material died between the 14th and 18th day. In contrast, only 3 of 8 mice succumbed in the group which received 2.5 mg. of the drug beginning on the 10th day after inoculation; these died between the 15th and 20th days. The majority of the mice which received 0.75 mg. daily were protected when the drug treatment was begun as late as 5 days after infection but not when it was begun 8 days afterward.

Results essentially identical with those just described have been obtained in embryonated eggs and mice infected with the agent of rickettsialpox (*R. akari*). Furthermore, the results of experiments in which embryonated eggs were infected with *R. prowazeki*, *R. mooseri*, *Dermacentroxenus rickettsi*, or the 6-BC or P-4 strains of psittacosis duplicated almost exactly those summarized in Fig. 1. A good chemotherapeutic effect was demonstrable in mice infected with the 6-BC strain. The antibiotic has been ineffective in the treatment of mice infected with Japanese encephalitis virus and in eggs infected with variola virus and influenza A virus.

Inasmuch as control mice and embryonated eggs which received amounts of the drug comparable to the maxima used in the above tests remained unaffected, Chloromycetin appears to be of low toxicity. Its low toxicity, its absorption from the alimentary tract, and its beneficial effect when given relatively late in disease suggest that it may be valuable in the treatment of patients.

Reference

1. Ehrlich, J., Bartz, Q. R., Smith, R. M., Joslyn, D. A., and Burkholder, P. R. *Science*, 1947, **106**, 417.

Initiation of the Cone Gall of Witch Hazel

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University of Virginia
Lucile Walton
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The control of growth and differentiation leading to the orderly development of the plant and animal body continues to be the central problem of biology. From Darwin and Herbert Spencer to the present time, theories of heredity have demanded some sort of controlling substance, whether envisaged as a physiological unit, a gemmule, a gene, or even as a hierarchy of biophores, determinants, and ids. In theories of the last 50 years the location of these units has been placed in the chromatin of the nucleus, and only recently have these specific, controlling, and self-propagating entities been ascribed to a location in the cytoplasm, the "plasmagenes" of Wright (*1*). A substance initiating, stimulating, and directing development and differentiation has been found in the cells of the cone gall of witch hazel (*Hamamelis virginica* L.). It is injected into the young leaf by "stings" of an aphid (*Hormaphis hamamelidis* Fitch) which feeds on the neoplasm induced by its presence.

The process of stinging is quite different from that of feeding. When stinging, the stem mother inserts her stylets into and between the cells of the young leaf and injects minute drops of a substance secreted by glands opening into the stylar canal. The sting substance cannot be confused with the salivary secretion because it shows characteristic staining reactions and properties of refraction.

Cells receiving the injected sting material dedifferentiate, undergo rapid mitotic divisions, and redifferentiate, not into cells of the normal witch-hazel leaf tissues, but into cells of other and different tissues which organize the gall. The cells show the effects of the stings immediately, and when about 150 stings have been made over a small circular area of the leaf, the cells of this area first become etiolated and then, by growth in size and number and by tissue differentiation produce the highly specialized cone gall. This is not a haphazard excrescence on the leaf, but in symmetry and harmonious unity of cells and tissues shows the same phenomena of functional adaptation that are familiar in the individual. It differs from an individual in its inability to reproduce.

The injected material, when stained with acid fuchsin and jod green consists of a blue ground substance in which minute crystalloids are embedded. The material of the crystalloids seems to pass readily from cell to cell, especially from phloem parenchyma to adjoining cells. The crystalloid is a tiny, refractory, deeply staining body characterized by its faceted appearance and showing a reddish or purplish cast in such stains as gentian violet, hematoxylin, safranine, congo red, acid fuchsin, basic fuchsin, Feulgen, and pyronine.

The behavior of the injected material is somewhat different when injected directly into the cytoplasm and when injected into intercellular spaces. When injected directly, it is seen first in the cytoplasm as a single globule containing, usually, one refractory crystalloid. The globule enters the nucleus and then the nucleolus, where the crystalloid breaks up into smaller bodies.

When the injection is intercellular, the globule is usually much larger and at first does not show crystalloids, though a small body showing the same staining reactions may be present. Crystalloids form within the globule which enters the leaf cells, occasionally the inner epidermal and spongy parenchyma cells, but much more often the phloem parenchyma. From the phloem parenchyma the sting material passes into palisade or even into cells of the upper epidermis. During its existence in the cytoplasm of the phloem parenchyma it may break up into smaller globules, each with its crystalloid or may lose its crystalloids singly into the cytoplasm. Whether injection is intra- or intercellular, the end result is the entry of the crystalloids into the nucleolus. There they may fuse to form a larger, single crystalloid which breaks up into smaller ones when the nucleus enters prophase.

As mitosis approaches, the bodies become more numerous, and are distributed to the daughter nuclei, where they are found in the nucleolus as they were in the mother nucleus. They appear not to be capable of self-propagation. For gall formation to continue normally, additional sting material must be injected repeatedly into the leaf. During the entire growth of the gall the stem mother continues to sting in intervals of feeding. Only the stem mother can initiate gall formation; no other generation in the life history of the aphid possesses this power. If the stem mother dies or is removed from a developing gall, growth of the gall soon ceases. Tissues differentiated in the gall do not revert to normal leaf tissues.

The gall may be looked upon as a neoplasm. Further studies are planned on the chemistry of the substance causing it to form. A detailed report of observations here summarized is in preparation.

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A Relationship Between Cystine and Pyridoxal or Pyridoxamine in the Nutrition of Certain Bacteria

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Cystine has been found to be essential for the growth of *Lactobacillus arabinosus* (*5*) and *L. casei* (*3*), although in a more complete synthetic medium it was reported to be unessential for *L. arabinosus* (*2*).

In experiments designed to assay cystine by *L. arabinosus* 17-5, using the medium of Stokes, *et al.* (*10*), near maximum growth occurred at 37° C. with no cystine added to the medium. It was subsequently found that the pyridoxamine in the medium eliminated the requirement of this organism for cystine (Table 1). Pyridoxal had the same effect, while pyridoxine had little or no effect on growth. Similar results were obtained with *Streptocccus fecalis* and *L. casei*, although cysteine was found by Dunn, *et al.* (*2*) to be essential for *L. casei* in a medium containing pyridoxal and pyridoxamine. The cystine requirement of *L. delbrückii* LD5 and *Leuconostoc mesenteroides* P-60, however, was not affected by the presence of pyridoxamine or pyridoxal, which agrees with results of Dunn, *et al.* (*2*). Similar effects of these compounds on certain other amino acid requirements of various lactic acid bacteria have been reported by Stokes and Gunness (*9*) and Lyman, *et al.* (*4*).

TABLE 1

INTERCHANGEABILITY OF CYSTINE WITH PYRIDOXAL OR PYRIDOXAMINE IN THE NUTRITION OF CERTAIN BACTERIA

(ml. 0.1 N NaOH/10 ml. culture)*

Organism	No cystine; no vitamin B_6	100 γ/ml. cystine; no vitamin B_6	100 γ/ml. cystine + 0.4 γ/ml. pyridoxamine†	No cystine; 0.4 γ/ml. pyridoxamine†	No cystine; 0.4 γ/ml. pyridoxal†	No cystine; 0.4 γ/ml. pyridoxine†
L. arabinosus 17-5 (A.T.C.C. #8014)	1.30	6.20	9.50	7.60	7.95	2.00
L. casei (A.T.C.C. #7469)	1.50	6.50	9.55	7.55	7.95	2.55
Str. fecalis (A.T.C.C. #9790)	1.50	6.60	6.70	5.75	5.90	1.70
Leuc. mesenteroides P-60 (A.T.C.C. #8042)	1.25	3.45	8.80	1.80	1.80	1.90
L. delbrückii LD₅ (A.T.C.C. #9595)	1.15	2.13	10.05	1.78	1.00	0.70

* Medium of Stokes, *et al.* (*10*), except for changes in cystine and vitamin B_6 group noted.

† Seitz-filtered; added aseptically to sterile medium.

When incubated at 30° C. instead of 37° C. with 0.4 γ/ml. of pyridoxamine but no cystine, *L. arabinosus* and *L. casei* grew slightly, while *Str. fecalis* grew almost equally as well as at 37° C. These data indicate that the mechanism whereby pyridoxamine replaces the cystine requirement of these organisms is not necessarily associated with the optimum growth temperatures of the organisms.

Since cystine is essential for *L. arabinosus*, *L. casei* and *Str. fecalis*, their growth in a medium deficient in cystine, but containing pyridoxamine or pyridoxal, indicated that cystine was synthesized from ingredients of the medium. To test this, *L. arabinosus* and *Str. fecalis* were grown 3 days at 37° C. and *L. casei* 6 days at 37° C. in the medium of Stokes, *et al.* (*10*) containing 0.4 γ of pyridoxal/ml. (Seitz filtered; added aseptically), but from which cystine was omitted. The washed cells were acid hydrolyzed and the hydrolysates assayed by *Leuc. mesenteroides* P-60. *L. arabinosus* contained 0.38 per cent, *L. casei* 0.65 per cent, and *Str. fecalis* 0.26 per cent cystine on the basis of dried cells. The cystine thus formed may originate from methionine, as shown by Tarver and Schmidt (*11*) to occur in rats fed methionine containing isotopic sulfur, and/or from serine, as reported by Stetten (*8*) to occur in rats fed serine containing isotopic nitrogen. Whatever the origin of the cystine, pyridoxal and pyridoxamine have an essential role in its synthesis in such a medium.

Some of the irregularities reported in the microbiological assay of cystine by *L. arabinosus* and *L. casei* (*1, 6*) can probably be explained by the presence of pyridoxal or pyridoxamine in the medium or in samples assayed. Also, a medium deficient in cystine but containing 0.4 γ of pyridoxine/ml., sterilized by autoclaving at 15 pounds pressure for 13 minutes, permitted considerable growth of these cultures. This was probably a result of pyridoxamine being formed by the interaction of pyridoxine and amino acids in the medium during sterilization (*7*), and indicates another reason for irregularities in the assay of cystine by *L. casei* and *L. arabinosus*. Furthermore, since temperatures from 30° to 37° C. are used for the growth of these bacteria, the degree to which pyridoxal and pyridoxamine contained in the medium replace the requirement for the added cystine varies with the particular temperature of incubation.

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Protection of Synaptic Transmission Against Block by Nicotine

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During the past year we have studied the effects of various drugs on synaptic transmission in the crayfish; the results will be described elsewhere. In the course of this investigation many drugs were found to have no effect. In such cases a check was made on the preparation by applying a dose of nicotine (10^{-5} grams/cc.) 10 minutes after the original drug. Control tests had shown that nicotine in this concentration blocks transmission in 1-2 minutes. As expected, the presence of most drugs did not influence this action. With some, however, either the nicotine was without effect or the block was greatly delayed. Evidently under certain conditions the preparation is protected against the action of nicotine. Since this situation seems to be of considerable interest, the following preliminary report is presented at this time.

The synapse used in these investigations is between a giant fiber in the central nervous system and a motor fiber in an abdominal root of *Cambarus clarkii* (*3*). The preparation was kept in a bath containing 100 cc. of crayfish perfusion fluid, the drugs being added to this bath. The giant fiber was stimulated between the 5th and 6th abdominal ganglia, while the postganglionic response was led off the 3rd root of the 3rd ganglion. Stimuli were delivered throughout the experiment at 30/minute, at which rate, in the absence of drugs, the postganglionic response remains unchanged for several hours.

The protecting effect was first noted with two drugs, anabasine and nornicotine,[1] which are closely related in structure to nicotine. In a typical experiment, anabasine 10^{-4} was administered. After a transient facilitation, transmission returned to normal. At the end of 10 minutes, nicotine 10^{-5} was given. This had no effect. Ten minutes later, nicotine 10^{-4} was administered, but even this high concentration had no effect for at least 10 minutes.

The results of similar experiments, made with a number of other drugs, permit the following classification to be made:

(a) Drugs which in low concentration protect the crayfish synapse from the action of nicotine, but which block the synapse in higher concentration: anabasine, nornicotine.

(b) Drugs which in subthreshold doses show no protection against nicotine and which block transmission in higher concentrations: alcohol, DFP, eserine.

(c) Drugs which neither protect against nicotine nor block synaptic transmission: acetylcholine, adrenalin, atropine, coramine, picrotoxin, prostigmine, strychnine.

An unexpected result was obtained in experiments in which the nicotine was left in the bath after transmission was blocked. Complete recovery of the root potentials occurred within 40 minutes. Renewed application of nicotine in the same or even higher concentration was now without effect. The same result was obtained when the preparation was washed with fresh perfusion fluid after block by nicotine.

A similar effect has been observed with eserine. After block by this drug, transmission rapidly returns to normal on washing with fresh fluid. Another dose of eserine, of even higher concentration, is now without effect. The preparation is also protected against the action of nicotine.

Protection against nicotine has been reported by other workers. Novocaine antagonizes the effects of an intravenous injection of nicotine on the heart, blood pressure, and intestine of the dog (*1*). Sulfathiazole inhibits the action of nicotine in the isolated intestine (*2*). The present study, however, has the advantage of confining drug action to synaptic transmission.

Biological competition between structurally related compounds is well known (*4*). In this type of action it is generally considered that the compounds involved compete for attachment to a specific receptor. Such a mechanism is not completely adequate to explain the phenomena described in the present paper, however. Nicotine evidently has a twofold action on synaptic transmission. When first applied, it blocks transmission. As recovery occurs, this blocking action is lost, but a protecting action remains, since further doses of nicotine are without effect. This shift from a blocking to a protecting action suggests that a change takes place in the nicotine molecule by which it becomes ineffective as a blocking agent but remains attached and thereby prevents the action of fresh nicotine. The attachment must involve a firm bond, since washing with perfusion fluid does not interfere with this protection.

Anabasine and nornicotine, which have much less blocking action, seem to attach as readily as nicotine and therefore protect against it. During recovery from nicotine block, nicotine may be transformed into a compound like these or into a related compound with a pure protective action.

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[1] We wish to thank R. C. Roark, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Beltsville, Maryland, for supplying these drugs.

Role of Inhibitors in Soybean

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It is now recognized that cooking or autoclaving increases the nutritive value of the protein of soybean. The general opinion is that cooking increases the availability of cystine and methionine. Almquist, *et al.* (*1*) and Hayward and Hafner (*8*) demonstrated that the limiting amino acid in soybean is methionine, and heating under pressure increases the availability of this amino acid. Evans and McGinnis (*4*) found that the retention of organic sulfur is increased from 34 to 52 per cent and that of methionine from 58 to 74 per cent in autoclaved soybean. But Melnick, *et al.* (*9*) found no increase in the retention of methionine in autoclaved soybean, and from their experiments they concluded that the higher biological value of autoclaved soybean was due to an increased rate of release of methionine rather than a higher degree of its availability. Ham and Sandstedt (*6*) found that a dilute acid extract of raw soybean contained a substance which greatly reduced the activity of trypsin *in vitro*. Ham, *et al.* (*7*) found that a solution of the partially purified inhibitor produced lowering of growth in chicks fed on a well-balanced diet. In a previous communication from this laboratory (*3*) it was stated that glycinin is more nutritive than autoclaved soybean. It was believed that the enhanced nutritive value of glycinin was due to elimination of the proteolytic inhibitor, as also any toxic factor which may be present in raw soybean.

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[1] Our thanks are due to V. Subrahmanyan for his keen interest in the work.

The present investigation was undertaken to see whether the presence of the inhibitor would affect the nutritive value of soybean protein digested with enzyme so that the amino acids are in free form. According to the hypothesis of Melnick, *et al.*, the biological value of the digest is expected to be higher than the raw bean, because all the amino acids, including methionine will be simultaneously available for utilization.

The digest was prepared by subjecting soybean meal to digestion by papain. Acid hydrolysis was not resorted to because it would destroy tryptophane and other possible essential peptide factors like strepogenin, as suggested by Woolley (*5*). Papain was chosen for the proteolytic digestion, since the raw soybean meal contained the tryptic inhibitor. The soybean meal was finely ground and suspended in about four times its weight of water and digested with an active preparation of papain. The digestion was carried out at 50°C. for 48 hours. A control was run, using a boiled solution of the enzyme which was maintained at the same temperature. Both samples were then dried in a current of warm air. It was found that the inhibitor was destroyed to a small extent in the course of drying. A requisite amount of the inhibitor solution extracted from raw bean was added to both the extracts in order to restore the original activity.

The biological value and the digestibility coefficient of the protein in the digested and control samples were determined by the usual nitrogen balance method. The proteins were fed at a level of 10 per cent (nitrogen × 5.7). The results are as follows:

	Average digestibility coefficient	Average biological value
Digested sample	89.6	45.9
Control sample	89.2	44.7

The nitrogen in the digested sample was analyzed, and it was found that 91.6 per cent of the total nitrogen of the meal was in the nonprotein form, as estimated by its solubility in 7 per cent trichloroacetic acid, and 90 per cent of the total methionine of the protein was in the free form in the digest.

From the above results it is evident that the role of the proteolytic inhibitor in deciding the nutritive value of raw soybean is not in diminishing the degree of availability or rate of release of methionine. It is highly probable that its action is of the nature of an antigrowth factor affecting the usefulness of proteins in general. This statement is supported by the findings of Ham, *et al.* that a purified solution of proteolytic inhibitor caused growth retardation in chicks fed on a well-balanced diet.

It is thought that, apart from the tryptic inhibitor, there may be other toxic factors associated with the raw bean which are destroyed on heating. Evidence for the existence of a separate factor apart from the proteolytic inhibitor was adduced from the following experiment. Everson, *et al.* found that the growth-promoting value of soybean protein increases to a marked extent if the bean is germinated. This observation was also confirmed here, and on examining the concentration of the proteolytic inhibitor in germinated soybean (48 hours) it was found that it was not altered from that in the original bean. The concept of the proteolytic inhibitor cannot explain this increase in nutritive value after germination. That there was no change in the amino-acid composition of the protein after germination was proved by Block, *et al.* (*2*), who could detect no change in the contents of tyrosine, tryptophane, phenylalanine, cystine, and methionine in the protein of soybean after germination.

From the above findings it can be postulated that apart from the proteolytic inhibitor there is a separate factor which affects the nutritive value of the soybean protein. Further work on the isolation of this factor and the respective roles of these inhibitors in the nutritive value of soybean is in progress.

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Effect of Benzene Hexachloride on the Flavor of Poultry Meat

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Tests conducted during the summer of 1947 show that the meat of chickens fed, sprayed, or retained in a house previously sprayed with benzene hexachloride has a distasteful flavor. This flavor, which makes the meat nearly inedible, persists for a period of 6–10 weeks.

The absorption of a benzene hexachloride flavor and odor was first discovered accidentally. In the fall of 1946 and spring of 1947 a number of chemicals were tested for the control of chicken mites. A paper on the results of these tests is in press for the *Journal of Economic Entomology*. During the course of this study several chemicals, including benzene hexachloride, showed promise, and a test to determine their toxicity to poultry was undertaken. A 5 per cent concentration of wettable benzene hexachloride containing 5 per cent of the γ isomer was applied to several chickens, the house, and the litter in December 1946. This test was concluded, and the house was not cleaned up or used until May 1947. At this time market birds were placed in the house and fed grain in the litter as well as mash in a feeder for a period of 1 week. When cooked, the meat of these birds was not edible because of a distasteful flavor apparently caused by the absorption of benzene hexachloride.

Since many manufacturers and promoters of insecticides had used and are now recommending benzene hexachloride in poultry houses, it was decided that a determination of the manner of absorption and persistence of the benzene hexachloride flavor should be made. To this end the following test was set up. Four chicken houses were selected. In one house, 5 birds were fed for 1 week with a mixture of 1 part of benzene hexachloride containing 6 per cent of the γ isomer in 200 parts of a mash-grain feed, and then transferred to the standard ration received by the other lots. In the second house, 5 birds were sprayed until wet with a benzene hexachloride suspension containing 0.25 per cent of the γ isomer. In the third, the walls were sprayed until wet with a benzene hexachloride suspension containing 0.25 per cent of the γ isomer and allowed to dry before the birds were placed inside. In the fourth house, which was isolated from the treated lots, 5 untreated birds were retained as controls. Sprays were applied with a 3-gallon compressed-air sprayer. The birds used were 2-pound White Leghorn cockerels.

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[1] With the cooperation of the Departments of Poultry Husbandry and Home Economics.

One of the birds in the lot receiving the treated feed died at the end of the first week. The bird apparently died of starvation, since the entire lot ate less than a pound of the treated feed in the 7-day period. One of the birds in the sprayed lot also died. These deaths reduced the samples from the 5 originally planned to 4. The remaining birds remained healthy until sampled and killed. The test was begun on June 13, 1947, and the final sample was taken on August 22, 1947.

TABLE 1

COMPARATIVE ABSORPTION AND RETENTION OF BENZENE HEXACHLORIDE ODOR AND TASTE BY CHICKENS

Treatments		Comparative rating of odor and taste			
		2 weeks	4 weeks	6 weeks	10 weeks
Feed treated	Odor Taste	Slight Slight	Moderate Moderate	Strong Strong	Strong Strong
Birds sprayed	Odor Taste	Moderate Strong	Strong Strong	Strong Strong	Moderate Slight
House sprayed	Odor Taste	Strong Moderate	Slight Slight	Slight Slight	Slight Moderate
Control	Odor Taste	Not checked Not checked	None None	Slight None	None None

The first 3 samples were taken at intervals of 2 weeks and the last after a 4-week interval. At sampling time 1 bird from each of the lots was killed and cooled. The following day the birds were roasted in separate ovens at uniform temperatures, no salt or other condiment being used. Five tasters or samplers then checked each bird, which was identified only by a code letter. Checks were made by smelling each of the partially carved carcasses and then tasting small pieces of white and dark meat cut from each bird. Each sampler recorded his own reaction to the quality of the particular meat.

The terms used to describe odor were very strong, strong, sharp, bad, slight, questionable and good; those used to describe taste were very strong, strong, acidic, musty, medicinal, biting, objectional, and good. The terms were modified into those used in Table 1, which gives the results of the test. Statements concerning the presence and comparative degree of an off-flavor or odor are included in the table only when the reactions of 3 or more of the samplers were the same.

In Vitro Resistance of the Genus *Bacteroides* to Streptomycin

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There is little reference to the genus *Bacteroides* in the growing literature on the *in vitro* sensitivity of various gram-negative bacteria to streptomycin. Since these microorganisms, normally saprophytic inhabitants of the nasopharynx (*16*), gastrointestinal tract (*11*), and the female genitalia (*13*), frequently invade the deeper tissues of the body to produce serious and often fatal disease in man (*19*, *20*), it seemed worth while to determine their sensitivity to streptomycin.

The obligate anaerobic, nonsporulating gram-negative bacilli comprising the genus *Bacteroides* are a heterologous group closely related to the genera *Dialister* and *Fusobacterium*. Bergey (*1*) lists 22 species of this genus, but since these have not yet been studied systematically, it is impossible to determine how many of them actually represent distinct species. Weiss and Rettger (*21*), for example, were able to classify 73 different strains into 4 serologic groups. Henthorne, Thompson, and Beaver (*14*) have reported that pleomorphic strains are serologically distinct from the nonpleomorphic strains. Therefore, following the convention adopted by Smith and Ropes (*20*), the strains reported in this study were classified as *B. funduliformis* if pleomorphic and *B. fragilis* if nonpleomorphic. Pleomorphism was determined by the formation of large bodies and filaments in artificial media and by a form of reproduction different than simple binary fission, associated with the production of anaerobic pleuropneumonia-like colonies (L-variation), as described by Dienes (*6*) and Dienes and Smith (*7–9*).

Four strains of *B. funduliformis* and 8 of *B. fragilis* have been encountered in this laboratory during the past year. These were isolated in primary culture on anaerobic ~~horse~~ blood or ascitic fluid agar plates, or in sodium thioglycollate broth. Subcultures were carried in chopped meat or sodium thioglycollate enriched with 30 per cent ascitic fluid and sealed with vaseline. All strains produced varying amounts of gas in these media and were characterized by a sharp, acrid odor. Strains were examined for pleomorphism and the production of anaerobic pleuropneumonia-like colonies by the cultivation and in situ agar block staining methods previously described by Dienes (*5*).

Streptomycin sensitivity was determined in unsealed 0.1 per cent sodium thioglycollate broth containing 0.1 per cent agar-agar, according to a titration based on the methods described by Price, Nielsen, and Welch (*17*). Streptomycin sulfate was diluted so that 4 times the desired doses were contained in 0.5-ml. volumes of broth. To these 0.5-ml. volumes was added 1.5 ml. of a 1:100 dilution of an 18- to 24-hour culture of the strain to be tested, giving a titration with final concentrations of streptomycin ranging from 4.0 mg. to 2.0 µg./ml. in a total volume of 2.0 ml. At the same time, each strain was tested for its ability to grow in the presence of 100 Oxford units of penicillin/ml. in the same medium. All titrations were examined after 48 hours incubation at 37°C. The first tube in which growth was inhibited was taken as the minimal inhibiting dose.

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All strains grew in the presence of 100 Oxford units of penicillin/ml. As may be seen in Table 1, *B. funduliformis* seemed to be somewhat more sensitive to streptomycin than did *B. fragilis*, although in either case the minimal doses of streptomycin required for inhibition were well beyond those usually obtainable *in vivo*.

TABLE I

In vitro RESISTANCE OF *Bacteroides* TO STREPTOMYCIN

Species	Strain No.	Source of culture	Streptomycin resistance	
			Inhibited by µg./ml.	Minimal inhibiting dose corrected for suppressive effect of thioglycollate and anaerobiosis
B. funduliformis	1	Subphrenic abscess	1,500	750
	2	Liver "	1,500	750
	3	Brain "	3,000	1,500
	4	Brain " , chronic otitis media	1,500	750
B. fragilis	5	Multiple buttocks, ischiorectal abscess	3,500	1,750
	6	Breast abscess	2,500	1,250
	7	Brain " , chronic otitis media	3,000	1,500
	8	Brain abscess, chronic otitis media	2,500	1,250
	9	Infected rectal tumor	3,000	1,500
	10	Stool	3,500	1,750
	11	"	2,500	1,250
	12	"	4,000	2,000

It has been reported that the presence of reducing substances in the medium interferes with the inhibiting action of streptomycin (*2, 4, 10, 12*). Opinion differs, however, on the inhibiting effect of sodium thioglycollate. Geiger, Green, and Waksman (*12*) found that thioglycollate agar did not inhibit streptomycin, while Donovick and Rake (*10*) reported that thioglycollate broth increased the minimal concentration of streptomycin necessary for the inhibition of *Klebsiella pneumoniae*. If streptomycin reacts with the sulfhydryl compounds containing basic amino groups in the vicinity of the —SH, as has been suggested by Cavallito (*3*), its inactivation could be brought about by the active —SH groups contained in sodium thioglycollate. However, the observations of Geiger, Green, and Waksman (*12*) with facultative anaerobes suggest that simple anaerobiosis, with the consequent accumulation of acid resulting from bacterial metabolism, may suppress the inhibiting action of streptomycin by as much as 50 per cent. However, as suggested by these same authors, as well as by Bondi and Dietz (*2*), the resistance exhibited to streptomycin by anaerobic microorganisms may be the result of differences in the metabolism of the anaerobes—streptomycin may more effectively block an enzyme system essential to the growth of aerobic bacteria.

In order to determine the effect of the presence of sodium thioglycollate on the *in vitro* streptomycin resistance of *Bacteroides*, representative strains of *B. funduliformis* and *B. fragilis* were tested for sensitivity to streptomycin in tryptic digest broth containing 0.1 per cent dextrose. The medium was boiled in order to remove dissolved oxygen and streptomycin sulfate titrated as previously described. Each tube of the titration was then sealed with a thick layer of vaseline and incubated at 37°C. for 48 hours. There was no significant difference between the results obtained by this method and those obtained in sodium thioglycollate with the same strains of *Bacteroides*. It might be mentioned also that in connection with another study (*15*), successive urine cultures collected from patients receiving streptomycin therapy were cultivated in sodium thioglycollate broth as well as on the usual aerobic media. In no instance was growth obtained in sodium thioglycollate, which theoretically should have inactivated the streptomycin present in the specimen, when growth was not obtained on aerobic media as well.

With the strains reported here, even if the observed minimal inhibiting dose is reduced by 50 per cent to allow for the possible suppressive effects of sodium thioglycollate and anaerobiosis, the concentrations of streptomycin necessary to inhibit the growth of *Bacteroides* still place them in the category of highly streptomycin-resistant microorganisms. The 3 strains of *B. fragilis* isolated from stools (Table 1) were recovered from patients receiving oral streptomycin. These apparently survived exposure to the very high concentrations of streptomycin obtained in the feces following oral therapy (*18*).

In view of the resistance of these microorganisms to streptomycin, together with the possible beneficial effect of sulfadiazine in one of the cases reported by Smith and Ropes (*20*), 2 strains of *B. funduliformis* and 5 of *B. fragilis* were examined for sensitivity to sulfathiazole and sulfadiazine. These tests were done in sterile, buffered ascitic fluid under vaseline seal. With the exception of a single strain, all 7 cultures so tested grew in the presence of 10 mg. per cent of either drug. The single exception, a strain of *B. fragilis* (Strain 4, Table 1), isolated from a brain abscess secondary to chronic otitis media, was inhibited by 10 mg. per cent of sulfadiazine but not by a similar concentration of sulfathiazole.

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IN THE LABORATORY

A Method for Determining the Volume of Small Solid Objects[1]

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Frequently it is difficult to determine with accuracy the volume of small objects of unknown density, especially when the object must be kept moist. In this laboratory we found it necessary to determine the volume of a large number of teeth which could not be permitted to dry. The most logical solution to this problem appeared to be the measurement of fluid displacement. The illustration shows the plan by which the fluid displaced by the object (F) is measured in a small-bore pipette. The potential accuracy of the instrument is primarily dependent on the ratio of the volume displaced to the bore of the pipette.

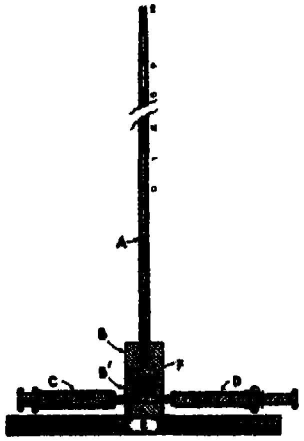

FIG. 1

The equipment consists of an ordinary graduated pipette (A), accurately faced methyl methacrylate blocks (B and B'), a large glass syringe (C), a smaller syringe (D), and a metal base (E). The syringes and the pipette are fitted into the plastic blocks through ground joints, making it possible to use various syringe combinations as well as pipettes of various sizes, provided that they are uniformly tapered. For our work, a 1-cc. pipette, a 2-cc. and a 1-cc. syringe were adequate. Stopcock grease should be used between the plastic blocks in order to prevent leakage. Volume determinations are made by filling both syringes and a portion of the lower chamber with distilled water. The upper section is then put in position and the plunger of the larger syringe inserted completely. The height of the water in the pipette is then adjusted to the zero mark by means of the smaller syringe. The plunger of the adjusting syringe should have a tension clamp to prevent free movement. Then, by withdrawing the plunger in the larger syringe, the water is removed from the upper unit and partially removed from the lower chamber. The blocks then are separated, and the object whose volume is to be determined is placed in the lower chamber. The upper unit is put in position as before, and the plunger of the large syringe is inserted completely. Since the same volume of fluid has been replaced in the system, the difference between the original height of the column and the present height is equal to the volume of the object in the chamber. The reading may be taken directly from the calibrated pipette. After each determination, the water column must be adjusted for the initial reading as described above. This method is rapid and, we believe, quite accurate. The size of the apparatus is dependent on the volume of the objects to be studied. Any fluid compatible with the materials in the apparatus may be used.

A Contact Culture Method for Detecting Molds on Surfaces

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A number of methods for the detection of molds on surfaces have been devised. In one of these (*2*) melted agar is placed on the surface to be tested, while in others (*1*, *3*) solidified agar is brought into contact with the surface. The method described below is of the latter type. It differs from other methods of this type in that a culture area equivalent to that in a standard-sized Petri dish is employed. The materials necessary for its preparation are readily available in the laboratory. The method has been used for culturing molds from contaminated surfaces in food plants. With the acid types of media employed yeasts also appeared on the plates, and by the choice of appropriate media the method could also be used for bacteria.

From a coarse type of filter paper discs approximately 8.5 cm. in diameter are cut, a small tab approximately 5 x 15 mm. being left on one side of each disc. The discs are soaked in a 0.5 per cent water solution of methylene blue until thoroughly colored and then rinsed in water to remove excess stain. When the rinse water is relatively free of stain, each disc is placed in a Petri dish and sterilized in the usual way by dry heat. Three ml. of melted sterile agar is added to hold the paper flat to the bottom of the plate. After cooling, 7 ml. of sterile agar, of appropriate composition to make a thin coating over the paper, is added. When the agar hardens, it is ready for use.

To test exposed surfaces in food plants for contamination with molds and yeasts, the agar-coated paper disc is removed

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[1] From research being aided through a grant from the Sugar Research Foundation.

aseptically by grasping the tab with sterile forceps and placed carefully, face down, upon the area under test. It is then removed and replaced in the Petri dish in its original condition.

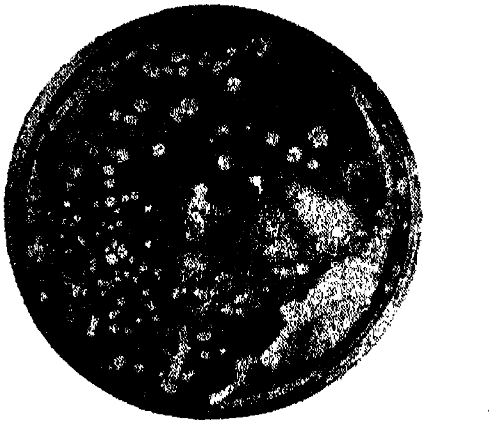

FIG. 1. Appearance of typical colonies on filter paper culture.

Mold and yeast growths may be noted in 24 hours with the Greenough microscope. Colonies usually become distinct within 48 hours. The blue paper is used merely to facilitate counting of the colonies. A typical culture is shown in Fig. 1.

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The Color Reactions of Sulfonamides With β-Naphthoquinone-4-Sulfonate

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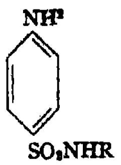
The reaction of β-naphthoquinone-4-sulfonate with amino groups to yield colored substituted naphthoquinones may be utilized as a qualitative method of differentiation for the various sulfonamides now used in antibacterial therapy.

For the purpose of detection and identification of the pure compounds or of the compounds in pure systems, the varying colors produced by the surface reaction of β-naphthoquinone-4-sulfonate solution with an aqueous suspension of the various sulfonamides, as well as the speed of the reaction or color formation, may be a useful device.

Reactions of the naphthoquinone were noted with p-aminobenzene sulfonamide (Sulfanilamide), 2-sulfanilamido thiazole (Sulfathiazole), 2-sulfanilamido pyrimidine (Sulfadiazine), 2-sulfanilamido-4-methylpyrimidine (Sulfamerazine), 2-(N^4-succinylsulfanilamido) thiazole (Sulfasuxidine), 2-sulfanilamido guanidine (Sulfaguanidine), and 2-sulfanilamido pyridine (Sulfapyridine).

All of these compounds with the exception of Sulfasuxidine contain a primary aromatic amino group and all except Sulfaguanidine have a portion of their structure in common:



Sulfaguanidine contains no hydrogen on the sulfonyl nitrogen attached to the guanidine carbon by a double bond.

The R moiety of the molecule varies in each case and this apparently influences the color of the compound formed and the speed of the reaction.

The test is carried out by suspending approximately 100 mg. of the sulfonamide in 5 cc. of distilled water in a test tube and adding 1.0 cc. of a 0.5 per cent solution of β-naphthoquinone-4-sulfonate as the sodium salt.[1] The color formation and color change are observed during the first minute and again after 5 minutes. The addition of 5 cc. of 10 per cent ammonium hydroxide provides a confirmatory test in some instances.

TABLE 1

Compound	Color after 1 min.	Color after 5 min.	Color after addition of NH_4OH
Sulfanilamide: *stable* bright orange suspension formed within 30 seconds	Bright orange	Bright orange	
Sulfathiazole: *rapid change* from yellow through orange to a brick red in 2–3 minutes, then to a reddish brown, and finally to a *stable* purple brown	Dark orange	Purple brown	
Sulfadiazine: *very slow change* from lemon yellow	Deep yellow	Orange yellow	Clear, deep brown changing to emerald green (differentiation from Sulfamerazine); *stable* for several hours
Sulfamerazine: *rapid change* from lemon yellow to orange yellow to orange (not as dark as Sulfanilamide and changes much more slowly)	Orange	Orange	Dark orange changing to clear, dark brown (differentiation from Sulfadiazine); *stable* for several hours
Sulfasuxidine: *stable* lemon yellow	Yellow	Yellow	
Sulfaguanidine: *rapid change* from yellow to a *stable* bright crimson within 30 seconds	Crimson	Crimson	Clear brown solution (differentiation from Sulfapyridine)
Sulfapyridine: *slow change* from yellow to orange (differentiation from Sulfaguanidine)	Orange	Crimson	Brown solution rapidly changing to emerald green (differentiation from Sulfaguanidine)

Results of the test using the compounds listed are shown in Table 1. It is thus possible to identify or to distinguish between various sulfonamide compounds now commercially available for therapeutic use.

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[1] Sodium β-naphthoquinone-4-sulfonate, Eastman Kodak Company.

Recording Uterine Contraction Patterns in Pregnant Women: Application of the Strain Gage in a Multichannel Tokodynamometer

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Present methods of studying uterine activity in women during the latter part of pregnancy give no indication of the pattern characteristics of the contracting uterus. Methods in use are essentially of two types. One records pressure from a single, isolated region transmitted to a tokograph which is applied to the abdomen externally (*1*). The other measures changing pressures by means of a balloon (or balloons) placed within the uterus during the course of labor.

The ideal method of recording uterine activity should yield information continuously concerning the nature of the activity in several parts of the uterus. The method described briefly below accomplishes this.

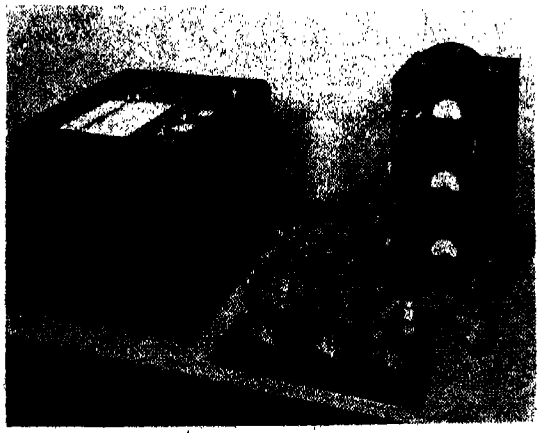

Fig. 1. Units of the multichannel Tokodynamometer. Right foreground: three strain-gage pick-up units mounted on brass rings described in text. (A later model of the dynamometer employs a smaller case and dispenses with the large plug.) Right rear: three-channel power supply and control unit. Left: frictionless writing unit containing three microammeters having insulated extensions on their pointers. Sparks, passing through a metal tip on the extension pass through the heat-sensitised paper which moves at a speed of 0.2 or 1.0 inch/minute.

The instrument which we have devised (Fig. 1) records electrically on a single piece of moving paper the uterine activity at each of three selected points on the ventral or ventrolateral aspect of the abdomen during the latter months of pregnancy. The principle employed involves application of the strain-gage dynamometer to direct electrometric recording through frictionless writing. The key to this method is the specially devised pick-up which makes it possible to apply a strain gage to the abdomen.

Pick-up device. Statham strain-gage dynamometers, Model YE-4-250, are so mounted on heavy (240-gram) brass rings that the sensitive element of the gage is connected by a simple lever system to an adjustable plunger (diameter, 7 mm.) held vertically in the center of the ring. Each of the three rings (⅜ inch wide; internal diameter, 47 mm.) is held in place on the abdomen by double-coated Scotch tape applied to the under side.

Power supply and circuit. The input current of each strain gage is derived from a 6-volt A battery and is controlled by a 200-ohm variable resistance, a 0.50 milliammeter, and a switch. The output from each gage goes directly to a Weston microammeter, Model 699, modified in such a way that it is balanced with a fine quartz tubing extension on its indicating arm. On the end of this is a small piece of 36-gage nichrome wire mounted vertically like a cross on a T.

Recorder. The recording unit now in use was made to our specifications by the Electro Physical Laboratories, New York City. It operates by distributing sparks through each of the three nichrome wire tips at half-second intervals. The sparks pass from a plate above to a plate below while a specially treated heat-sensitive paper passes over the lower plate at the rate of either 5 or 25 mm./minute. A heated point marks minute intervals at the bottom of the paper. The tips of the ammeters swing freely between the metal plates and over the paper without touching either, *i.e.* by frictionless writing. The instrument is so sensitive that the top of the unit is enclosed in a plastic case during recording to prevent disturbance from air currents.

The records of uterine contractility consist of a series of fine holes burned through the paper in the position under the nichrome tip according to its position at the instant of sparking. This position depends upon the amount of pressure applied to the plunger described above.

Operation. In operation, the gages are secured at the sites of choice in the manner described. The plunger is adjusted so that the needle of each ammeter is just slightly deflected. By turning a single switch on the recorder, the paper starts moving and the sparking mechanism begins to record.

To analyze the records obtained, the gages are calibrated by hanging gram weights (up to 75 grams for full-scale deflection) on the lever arm of the pick-up unit. These are noted on three scales inscribed on a sheet of Lucite in which the divisions are marked on curved lines directly over and matching the radius of curvature of the swing of the ammeter when this is recorded on stationary paper. In addition to these marks, a cut-out is made at the bottom of the Lucite plate with one side of the opening matching the time line. By placing the plastic plate over a portion of a record, the force exerted against each plunger of the pick-up may be read directly at any moment, and, in addition, time events on any one curve or the time relations between any part of the several curves may be read by appropriate marking of the record on the time line. In this way, simultaneous ordinates are automatically obtained for the three curves.

It has been ascertained recently that an ink-writing, two-channel recorder made by the Brush Development Company, Cleveland, works equally well with the pick-ups which we have devised. This unit consists of one DC amplifier for each channel (Number BL 913) and one Double Channel Magnetic Oscillograph (Number BL 202), modified by adding a slow-speed motor (10 r.p.m.).

The instrument just described has been designated a Tokodynamometer (Toko = pertaining to birth; dynamometer = measurement of force). The records obtained are *tokodynagraphs*, conveniently abbreviated TKG.

The applications of the Tokodynamometer will have to be determined by use. At present it is clear that it will serve as a tool for research in studying uterine dyskinesias, pharmacological responses of the uterus, contraction patterns in labor, and so forth. It also seems clear that it will serve as a teaching aid to student obstetricians in analyzing types of uterine activity at and near term. It is conceivable that the Tokodynamometer may prove to be of prognostic value by indicating within the limits of statistical probability the relation of the contraction pattern observed in a uterus a short time before term to the subsequent clinical course of labor.

A detailed report of the construction of this unit, including wiring diagrams, drawings, and photographs will be made at a later date in another journal.

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Freezing Points of Cobalt and Nickel and a New Determination of Planck's Constant C_2

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The International Temperature Scale (*3*) adopted in 1927 by the Seventh General Conference of Weights and Measures is based on a number of fixed points, the temperatures of which are defined. The highest temperature of these is the freezing point of gold, defined as 1,063°C. Above the gold point the temperature scale is extended by means of Wien's law of radiation. In this range any temperature, t, is determined by the ratio of intensity, J_2, of monochromatic visible radiation of wave length λ cm., emitted by a black body at temperature t, to the intensity, J_1, of radiation of the same wave length emitted by a black body at the gold point, by means of the equation:

$$\log_e \frac{J_2}{J_1} = \frac{C_2}{\lambda}\left(\frac{1}{1{,}336} - \frac{1}{t+273}\right). \qquad (1)$$

A value of 1.432 cm.-degrees was assigned to the constant C_2. The equation is valid only if the product $\lambda(t + 273)$ is less than 0.3 cm.-degrees.

The assignment of the value 1,063°C. to the gold point was based primarily upon the gas thermometer work of Holborn and Day (*7*) and of Day and Sosman (*4*). Day and Sosman extended the constant-volume nitrogen thermometer scale up to 1,550°C. by obtaining the temperatures of various fixed points, including the freezing points of copper, nickel, cobalt, and palladium. The present authors were very fortunate to have available for this work samples of nickel and cobalt from the same lots of these materials used by Day and Sosman. Thus, the freezing points of these materials on the International Temperature Scale could be compared directly with the values determined on the gas thermometer scale. Although this comparison of temperature scales was the primary object of the present work, the samples of nickel and cobalt were of such purity that the observed values of the freezing points are the same, within observational error, as those of the pure metals.

A detailed discussion giving the sources and the analyses of the metals used by Day and Sosman in their gas thermometer work is given on page 85 of reference 4. The analyses of the nickel and cobalt ingots made at the conclusion of the present work gave essentially the same results as those originally reported by Allen, of the Geophysical Laboratory.

The so-called crucible method was used in the freezing-point determinations. In this method the radiation from a hollow enclosure or black body immersed in the molten metal is observed with an optical pyrometer as the metal freezes. In the present work the metals were melted in a high-frequency induction furnace.

Beryllia and thoria were used as crucible materials, thoria proving more satisfactory because of its greater mechanical strength. Freezing-point determinations were made in an atmosphere of helium and *in vacuo*, since both metals oxidize readily at high temperature.

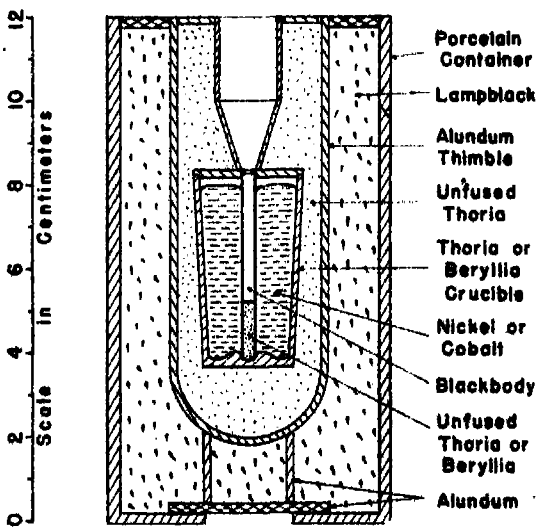

FIG. 1

Fig. 1 is a cross-sectional view of the crucible assembly. The 80-gram samples of nickel and cobalt were first melted in beryllia crucibles of the size and shape to be used in the freezing-point determinations. A hole was drilled axially in each ingot to accommodate the sight tube. The sample and its sight tube were placed in a refractory-oxide crucible and mounted in a larger porcelain container, as shown. The relatively coarse insulating material surrounding the crucible permitted the passage of gas around the sample, while the lampblack provided excellent thermal insulation. The assembly shown was placed inside a closed Pyrex tube having a Pyrex window sealed to the top with propylene phthalate. The Pyrex tube fitted closely inside the water-cooled coil of the induction furnace.

Before melting the sample in a helium atmosphere, the gas was passed slowly through the Pyrex enclosure for about 16 hours before heating, as well as during the actual heating. For the experiments *in vacuo*, the pressure within the enclosure was maintained less than 0.005 mm. of mercury by a mercury diffusion pump. A liquid-air trap between the diffusion pump and the Pyrex tube prevented mercury vapor from entering the tube.

The optical pyrometer used was designed by Fairchild and Hoover (*5*). It was fitted with a 45° total-reflecting prism for sighting into the black body. Two separate pyrometer lamps were used during the investigation. For observations on the black body at the gold point, an assembly of the same dimensions as that shown in Fig. 1 was used.

The brightness ratio, J_2/J_1, was measured by utilizing a rotating sector disk. The sector had two openings and was made by mounting steel strips on an aluminum disk. The edges of the strips were ground, and lapped straight and aligned to be radial with the aid of a circular dividing engine. The transmission of the sector, as computed from the measurement of the openings with a circular dividing engine, was 2.625 per cent.

In addition to using the sector disk, an absorption glass was used to obtain temperature measurements at the freezing points of the metals. This had been calibrated repeatedly by comparison with sector disks over a period of about 20 years, and the calibration is considered well established.

TABLE 1

Lamp No.	Absorption device	Nickel		Cobalt	
		No. of freezes	Avg. value of freezing point (°C.)	No. of freezes	Avg. value of freezing point (°C.)
F-16	Glass	10	1,455.0	22	1,494.7
F-16	Sector	29	1,455.3	13	1,494.8
L-1	Glass	18	1,455.3	22	1,494.4
L-1	Sector	7	1,455.0	4	1,495.3
Weighted mean			1,455.2		1,494.7

About 60 freezes on each metal were made, with both authors serving as observers. The average number of pyrometer settings during one freeze was 7. About 10 freezes on each metal were made with the samples *in vacuo* and the remainder with the samples in helium. No significant differences were noted.

A summary of the determinations of the freezing points of nickel and cobalt obtained by use of equation (1) is given in Table 1.

In view of estimated uncertainties, the best values of the freezing points are taken as 1,455 ± 1°C. for nickel and 1,495 ± 1°C. for cobalt.

The ratios of brightness (J_2/J_1) of black bodies at the freezing points of nickel and cobalt to that of a black body at the gold point were found to be as follows: for nickel, where $\lambda = 0.6533\mu$, $J_2/J_1 = 41.40$; and for cobalt, where $\lambda = 0.6532\mu$, $J_2/J_1 = 54.99$.

Using the values of the freezing points of gold, nickel, and cobalt as determined by Day and Sosman, and the above values of the ratios of brightness, values of the constant C_2 in Planck's law of radiation can be calculated. For simplicity, Wien's law is used in the calculations, since it gives essentially the same numerical results as Planck's law in the temperature range investigated. Since the values of Day and Sosman for the temperatures of the various fixed points are on the constant-volume nitrogen scale, small corrections are necessary to convert them to the thermodynamic scale (*2*, *8*). Wien's law yields the following expression for C_2:

$$C_2 = \frac{\lambda \log_e \dfrac{J_t}{J_{Au}}}{\dfrac{1}{t_{Au} + 273} - \dfrac{1}{t + 273}}. \qquad (2)$$

In addition to the samples of nickel and cobalt used in the present work, Fairchild, Hoover, and Peters (*6*) have measured J_t/J_{Au} for a sample of palladium, which was compared with the palladium used by Day and Sosman and found to have the same freezing point to about 0.1°C. Table 2 lists the values of C_2 as derived from these points.

Since the adoption of the International Temperature Scale there has been considerable evidence to indicate that the value assigned to C_2 is low. The International Conference of Weights and Measures was scheduled to consider revision of the temperature scale in 1939, but failed to meet because of unsettled political conditions. One of the proposed revisions was to increase the value of C_2 to 1.436 cm.-degrees. Since 1939 there has been additional evidence that the value should be still higher.

TABLE 2

VALUES OF C_2 BASED UPON OPTICAL AND GAS THERMOMETRY

Fixed point	Temperature D&S gas scale (°C.)	Thermodynamic scale (°C.)	$\log_e \frac{J_t}{J_{Au}} \times 10^7$	C_2 (cm.-degrees)
Au	1,062.4*	1,062.6		
Ni	1,452.7*	1,453.1	2,433	1.436_4
Co	1,490.6*	1,491.0	2,618	1.439_5
Pd	1,549.4*	1,549.8	2,879	1.438_2
Mean				1.438

* These values are the unweighted means of the individual determinations of Day and Sosman and are slightly different from the weighted means reported by those authors.

Values of the constant C_2 may be computed by a number of methods. Wensel (*9*) discusses these methods and summarizes the values of C_2 as obtained from the various sources. The particular value of C_2 which was given the greatest weight was that derived from the atomic constants. In the most recent summary of the physical constants, Birge (*1*) concludes that C_2 equals 1.4384_8 cm.-degrees. Thus, the present results add to the evidence that the most probable value of C_2 is 1.438 cm.-degrees.

A more detailed paper on this subject will be published in the *National Bureau of Standards Journal of Research.*

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Book Reviews

Adolescent sterility: a study in the comparative physiology of the infecundity of the adolescent organism in mammals and man. M. F. Ashley Montagu. Springfield, Ill.: Charles C. Thomas, 1946. Pp. ix + 148. (Illustrated.) $3.50.

Any contribution to the understanding of the problem of human sterility is of considerable importance, for sterility in the human seems to be increasing. Prof. Montagu has made such a contribution in this volume. He brings together evidence from both comparative (mammalian) and human physiology that the onset of menstruation does not coincide with the ability to conceive. It is this interval between the first menstrual period and the first conception that is known as the period of adolescent sterility. Ovulation is not associated with the first menstruation, but follows sometime later, the number of years varying considerably in any given population. The physiological basis for the period of adolescent sterility is hormonal control. The mechanism that starts and maintains menstruation is not the same as that which initiates ovulation, the latter being the later and more mature function. During the interval between the first menstruation and the first ovulation the organism does not remain static, but matures the sexual equipment essential for the process of reproduction.

Prof. Montagu's book is most highly recommended to every physician whose practice involves obstetrics, gynecology, and endocrinology.

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Curare: its history, nature, and clinical use. A. R. McIntyre. Chicago: Univ. Chicago Press, 1947. Pp. vii + 240. (Illustrated.) $5.00.

Curare, the arrow poison of South America, is as scientifically interesting and exciting to the biologists of today as it was intriguing to the early explorers who discovered it and the natural philosophers who first wrote accounts of it. In the large scientific literature on this subject which is added to monthly there is at present no single publication of broader scope or more profound learning on the subject than the present study. Dr. McIntyre and his associates during the last 6 years have accomplished a large amount of experimentation on the physiological and pharmacological effects of curare. In this volume he not only undertakes to place all of this experimental material, including the work of others, in an orderly review, but also provides a very scholarly historical background for the whole subject. In developing the history of curare he has been able to correct numerous errors and false impressions. He shows the relation of this and other poisons to the beginnings of modern toxicology and the development of modern physiology. Numerous quotations have been included from several of the earlier, more significant accounts, particularly from witnesses who observed the preparation of the poison extracts which were to be used by the Indians in the Amazonian jungles.

Historical notes and references occur throughout the volume, but the major portion of the book is devoted to the presentation of a wide range of experimental work. Full chapters on the botanical and chemical aspects of curare are provided, tracing these lines of study from earliest times up to the present. Other chapters cover: nerve and muscle, circulation and respiration, the viscera, the central nervous system, absorption and excretion, and toxicity. There is a chapter on theories of curarization and one entitled "Miscellaneous Effects of Curare."

Laboratory studies already completed demonstrate that curare can be used successfully in connection with shock therapy to control and prevent trauma and is useful as an adjuvant in anesthesia. Details are given for the administration of the drug for these purposes, and the anticipated clinical results are discussed. Dr. McIntyre proposes areas where new or more extensive experimentation with curare appears to offer promise of developing further therapeutic uses. The work is noteworthy also as a bibliography on curare, since each chapter contains full references to the authors cited, and these pages make up nearly 25 per cent of the total. Subject and author indexes are very adequate. The University of Chicago Committee on Publications in Biology and Medicine has sponsored this book.

WALTER R. MILES

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Injection molding of plastics. Islyn Thomas. New York: Reinhold, 1947. Pp. viii + 534. (Illustrated.) $10.00.

Although the first patent on an injection molding machine was granted in 1878, this is the only comprehensive book to be published on the subject. The first part of the book is devoted to the history of injection molding, giving a detailed description of many of the commercial machines, both past and present; the characteristics of thermoplastic molding powders, information which the molder can use as a basis for selecting the proper plastic; general techniques and guiding principles for the molding of different types of thermoplastic materials; recommendations for laying out a molding plant, including a description of the necessary auxiliary equipment, storage space, utility requirements, etc. The latter half deals with mold design and construction, product design and finishing, cost estimation, and finally ends with tables on the physical properties of plastics.

The text is written in language which both the layman and engineer can understand; the hundreds of illustrations serve to increase its instructiveness. Very few references are quoted other than Modern Plastics although a good portion of the data, it appears, has been taken from trade literature. The author has rendered a valuable service in selectively assembling so much authoritative information on injection molding. His treatise should help ease many of the costly headaches involved in gaining experience in the molding field.

J. M. GRIM

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Sludged Blood

Melvin H. Knisely, Edward H. Bloch, Theodore S. Eliot, and Louise Warner

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THIS PAPER CONSTITUTES A BRIEF INtroduction to a series of observations made mostly with microscopes in living animals and men which leads to a more precise understanding of a variety of mechanisms whereby injuries and diseases damage the human body. It is felt that these observations clarify a group of fundamental ideas, explain many old experiments, and make the solution of several groups of currently perplexing problems quite simple. The observations also permit, and we think necessitate, a subdivision and reclassification, a much-simplified and, for guiding investigations, a more useful classification of many of the currently known pathologic mechanisms of the diseases of animals and men. Our purpose is to present and define certain properties of normal blood, blood flow, and vessel walls; to offer evidence that these properties are necessary to the normal functioning of the circulatory system; to describe certain visible responses of the vascular system and/or blood to specific stimuli; to describe certain visible pathologic structures and processes; and to define goals now necessary for therapeutics.

The material presented is an outline and summary of 16 years of observation and experimentation during which two major methods have been used. Living animals—frogs, salamanders, mice, rats, guinea pigs, cats, rabbits, dogs, and monkeys—have been carefully anesthetized and operated upon, and internal organs such as striated muscles, smooth muscles, gastrointestinal tract linings, surface areas of brain, peripheral nerves, uterus, spleens (*22*), livers (*27*), omentum, mesenteries, frog kidneys, etc. exposed. Parts of these organs have then been transilluminated with light-conducting fused quartz rods (*23*) and studied with microscopes at 16–600 × magnifications. This was necessary in order to learn about the structure, dimensions, and natural behavior of the blood and vessels of living internal organs.

Since 1941 binocular dissecting microscopes have been focused on the obliquely illuminated bulbar conjunctival vessels of living, unanesthetized, unoperated animals and men (*25*). When skilfully used, this method causes almost no discomfort to most subjects (*16, 28, 29, 45*) (see cover). Because the blood is thoroughly swirled and mixed in the chambers of the heart and the arch of the aorta, this method permits continuous, careful study of a statistically valid sample of all the subjects' circulating arterial blood (*29*). It also permits study of one set of small human vessels, including both their vasomotor conditions and responses (*3, 11, 14, 30, 38, 49*) and various aspects of the normal and/or pathologic reaction states of their walls (*6*). Magnifications of 32, 48, 64, and 96 × have been used.

The dimensions of many observed structures have been measured or estimated closely with transparent scales mounted in the microscope ocular or recorded in motion pictures.

HEALTHY, NORMAL BLOOD AND VESSEL WALLS

In the internal organs of about 3,500 healthy frogs, 1,100 salamanders (*Amblystoma*), and 500 laboratory mammals anesthetized with pentobarbital sodium and in the bulbar conjunctiva of 50 healthy, unanesthetized medical students and student nurses the following observations have been made:

(1) The circulating red cells not only were not agglutinated but tended to repel each other slightly. In carefully handled tissues red cell rouleaux were not present. The normal red blood cells were not coated with any microscopically visible protein precipitate. The fact that they show no tendency to adhere to each other *in vivo* is evidence that they are not coated with any very thin, transparent, or otherwise invisible sticky precipitate. These observations are in strict agreement with those of many

The work described in this article was aided by grants from the Dr. Wallace C. and Clara A. Abbott Memorial Fund of the University of Chicago and from the Winthrop Chemical Company; and by the Tennessee Valley Authority, which initiated this general study of sludged blood through its cooperative program with the University of Tennessee for studies on malaria because patients with many diseases have symptoms similar to those with malaria.

The authors are deeply grateful to Dr. Louis Levy of Memphis for the loan of a universal slit lamp and corneal microscope, without which these studies could not have been initiated; to Roche-Organon, Inc., of Nutley, New Jersey, for generously supplying the heparin used in the study; and to Profs. Robert R. Bensley, Preston Kyes, Frank L. Roberts, Paul Brandt-Rehberg, and August Krogh for suggestions and criticisms which have guided the observations and experiments.

previous investigators (*1*, *2*, *26*, *35*, *36*, *44*). The observations of unagglutinated blood cells in young, healthy human beings are particularly valuable as a strict control for animal experiments since these human beings had not been subjected to fright, anesthetics, or operations.

(*2*) No white cells or erythrocytes stuck to the inner surfaces of the walls of small vessels. The inner surfaces of the linings of normal small vessels were smooth and clean (*6*, *35*, *36*).

(3) The flow of the unagglutinated blood was laminar or "streamlined." In small arteries and veins the blood cells were in an axial stream and around them was a peripheral concentric layer of plasma (*30*, *44*, *49*, *50*). The cells of this stream were arranged in concentric laminae, the center one passing along most rapidly and each additional layer passing more slowly than the one inside it. The wall of each lamina of this system consisted of unagglutinated blood cells; each layer was exactly one red cell thick (cinema recorded). This arrangement of unagglutinated blood cells in fluid plasma is a necessary part of the highest degree of good health, as the next and succeeding paragraphs show.

The rates of flow of blood through each tissue of each organ of the body set the maximum rate at which the cells of that tissue can receive blood-borne materials. For this discussion the most important of these is oxygen: it is necessary to all cells of the body, it is not stored in the body, and even slight local oxygen deficits are known to begin to upset many factors of physiology. The rates of flow of blood through each tissue are precisely controlled by the narrowest and/or most powerfully contractile vessels in the tissue, the arterioles, terminal arterioles, contractile sphincters, etc. In healthy animals the diameters of these vessels may remain nearly constant under uniform experimental conditions or may change from moment to moment as parts of *necessary* physiological adjustments of the rates of supply of oxygen and glucose to tissues, the rates of removal of waste materials and heat from tissues, or the rates of delivery of blood to some organ (e.g. kidney, spleen, skin, liver) which performs some special indispensable function upon the blood it receives (*27*).

The diameter of each and every small vessel is determined at any time by the balance between the outward blood pressure and the current degree of contraction of the smooth muscle and/or other contractile elements of the vessel wall, plus, in some tissues such as muscle, the varying pressure of surrounding structures. The small vessels are not capable of infinite physiological dilatation, for, if the contractile elements are maximally relaxed, the diameters are then determined by the length, elasticity, and elastic limit of the connective tissue fibers which form a close-meshed basketwork surrounding every vessel.

During health the physiological changes in the diameter of each and every set of small vessels are precisely controlled by changes in the degree of contraction of the contractile elements of the vessel wall, in response to changes in the equilibrium between "constrictor and dilator" substances which can reach the vessel wall by three paths—from blood flowing through the vessel, from cells of the particular tissue or organ around the vessel, and from nerve endings in, upon, or near the vessel wall. The responses of the contractile elements are also continuously affected by temperature changes in the tissues around vessels and in the entering arterial blood. Many of these reaction patterns are exceedingly complex (*22*, *27*); all are necessary parts of the internal adjustments of normal good health. The previously described arrangements of the semisolid blood cells suspended in the moving plasma cause the *minimal internal friction* in the columns of blood in arteries and veins, thus permitting the available pressure drop along each open vessel to cause the most rapid possible rate of blood flow through that vessel. As a direct, and most important, consequence of this, every homeostatic dilatation of any set of small vessels is immediately followed by the maximum hydrodynamically possible increase in the rate of flow of blood through that set of vessels and the maximum possible increase in the rate of supply of oxygen, rate of removal of wastes, etc.

(4) The small, normal vessels of most tissues and organs did not leak appreciable amounts of fluid for (a) there was no visible hemoconcentration occurring (*30*, p. 14); (b) in the mesenteries and omentum of animals the fat cells outside vessels were tight together, not pushed and held apart by escaping fluid; and (c) in human beings the bulbar conjunctiva was not forced up and held away from the sclera, whereas this does occur and can easily be seen with stereoscopic microscopes in human beings at times when visible continuous hemoconcentration is occurring in leaking bulbar conjunctival vessels. The complicated permeability phases of spleen and liver vessel walls are described elsewhere (*22*, *27*).

(5) The blood flowed so rapidly in most arterioles and venules which were from 60 to 120 μ in diameter that individual red cells could not be seen. This is a crude but accurate and useful criterion for adequate rates of blood flow through most open-tissue capillaries. If the rates of flow of oxygen-saturated arterial blood are fast enough so that individual unagglutinated blood cells cannot be seen in vessels of this size in normal animals and men, high magnifications show that no visible hemoconcentration is taking place in capillaries, *i.e.* almost no blood fluid is being lost through the walls of the tissue capillaries.

(6) The shapes and dimensions of the vessels of the peripheral vascular beds constitute a perpetual bottleneck in the circulatory system. All the vessels which carry blood toward tissues are long, narrow, slowly tapering, truncated cones. When arterioles branch, each branch has a narrower lumen than that of the parent stem. The capillaries or sinusoids which carry blood through tissues are approximately cylinders, and the veins are slowly widening cones again. Arteriovenous anastomoses have been

found in some tissues, but these have small total surface areas; if oxygen, glucose, and other blood-borne anabolites are to be distributed effectively to the cells of a tissue, the blood must flow through the capillaries or sinusoids of that tissue.

We have found that almost every whole arteriole-to-capillary or sinusoid-to-venule pathway can contract tightly shut throughout its length, making its internal diameter zero and thus forcibly resisting the entrance of blood, and that individual parts or all its parts can dilate maximally (*27*). As noted, the pathway is not capable of infinite physiological dilatation because of the elastic limit provided by the basketwork of connective tissue fibers surrounding each arteriole. Forcibly dilated capillaries begin to leak proteins and do not retain blood plasma.

In the internal organs of the mammals we have examined, the open arteriole tips were, for the most part, narrow enough so that every red and white cell passing through was forcibly distorted—usually pinched and elongated or folded. This is also clearly shown in frogs in a motion picture prepared by Fulton and Lutz (*14*). The capillaries through which blood is flowing normally vary from a little less than once to as much as two to two and a half times the diameters of the passing red cells. Most true capillaries can dilate without losing tonus, weakening and sacculating to a little more, but not much more, than two or two and a half times the diameters of the animal's own red cells.

These statements are true of the arterioles and capillaries of the bulbar conjunctiva of human beings, whose red cells are usually a little less than 8 μ in diameter, and almost certainly true of all the arterioles and capillaries of most human organs during life. Thus, as is well known but not always remembered, under all conditions of health and disease the arterioles and capillaries are a perpetual bottleneck in the vascular system.

Normal, unagglutinated, circulating blood and normal vessel walls of monkeys have been recorded in colored motion pictures (see Reel 1 of the motion picture, "Knowlesi Malaria in Monkeys," *29*).

One other aspect of normal circulation, although important, has not been studied in living human beings. In living frog and rhesus monkey livers the normal naked red cells slide and bump along the surfaces of the highly phagocytic cells which line the hepatic sinusoids, but *no normal naked red cell has ever been observed to be ingested.* These phagocytes continually "ignore" normal naked erythrocytes (*27*).

The factors of normal blood, blood flow, vessel walls, and vascular behavior listed above set the stage for recognition, understanding, and evaluation of, and planning new therapy for, a variety of factors of circulatory pathology. Once any anatomical, physiological, behavioristic, or chemical aspect of normal healthy animals or human beings can be sharply recognized and clearly defined, all detectable deviations from that aspect of the normal can also be recognized and defined. Once a *kind* of deviation can be defined, the detectable degrees of that kind of deviation can be arranged in scales whose extremes are the minimal perceptible deviation from normal and the maximal degree of that deviation which can exist and still have life continue. The return of each kind of pathologic deviation to the previously defined healthy normal then becomes an immediate and continuing goal of rational experimental and applied therapeutics.

THE CIRCULATING BLOOD OF HUMAN PATIENTS

In about 600 unanesthetized human patients diagnosed by practicing physicians as having a wide variety of pathologic conditions and diseases, we have seen the blood cells agglutinated into masses (not rouleaux); this changed the blood from its normal, relatively fluid state, to a circulating sludge. The variety of the diagnoses is attested to by the following partial list, which includes the number of patients seen with each[1]: bronchiectasis, Buerger's disease, large acute burn, diphtheria, eclampsia, acute streptococcal endocarditis, gonorrheal salpingitis, granuloma inguinale, hysteria, chronic lymphatic leukemia, uncomplicated vivax malaria, multiple myeloma, normal uncomplicated pregnancy, thyrotoxicosis, typhus fever, whooping cough, traumatic shock without external hemorrhage (1 each); bronchitis, lung abscess (nontuberculous), malignant hypertension, measles, myelogenous leukemia, multiple sclerosis, subacute bacterial endocarditis, trichinosis, tularemia, Weil's disease[2] (2 each); nephritis, portal cirrhosis, smallpox, thrombopenic purpura, typhoid fever, varicose leg ulcers (3 each); common cold (4); meningococcic meningitis, neoplasms of testis, colon, esophagus, pancreas, and one of unknown primary origin with multiple metastasis (1 each); traumatic shock complicated by hemorrhage and acute alcoholism (automobile accident cases) (5 each); scarlet fever, sickle cell anemia (6 each); acute arsenical reactions (7); gonorrheal arthritis, syphilis of the central nervous system (8 each); acute rheumatic fever (9); central nervous system syphilis under treatment with falciparum malaria (11), with vivax malaria (10), with quartan malaria (18); undulant fever (13); pneumococcic pneumonia (18); acute alcoholism

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[1] The patients in these lists were studied at the John Gaston Hospital, Memphis, Tennessee, where the investigation was initiated, the Iroquois County Hospital at Watseka, Illinois, where the undulant fever patients were available, and the Municipal Contagious Disease Hospital, the Municipal Tuberculosis Sanitarium, Michael Reese Hospital, Billings Hospital, and the Chicago Lying-in Hospital in Chicago. The administrative officials and staffs of these hospitals have all been most generous and cooperative in creating opportunities for us to study their patients. Many physicians have taken considerable time to be certain that we studied very carefully diagnosed patients. Among these are L. W. Diggs of Memphis, who provided the sickle cell anemia patients; Earl Roberts of Watseka, the undulant fever patients; Gilbert Levi of Memphis and Archibald Hoyne of Chicago, patients with highly infectious diseases; Henry C. Sweany, patients with tuberculosis; and Charles Dunham of the University of Chicago, the arthritis patients. To these and many others we are deeply grateful.

[2] The agglutinated circulating blood of one Weil's disease patient was photographed on Eastman Supersensitive XX 16-mm. movie film.

(20); acute anterior poliomyelitis (21); heart disease (luetic, 5; arteriosclerotic, 15; pericarditis, etiology unknown, 2; rheumatic, (6); pulmonary tuberculosis (58); and rheumatoid arthritis (125).

Odell, Aragon, and Pottinger, using a modification of our apparatus, have studied the circulating blood of 21 women with normal uncomplicated pregnancies and found sludged blood in 12. Of 23 women with various pathologic complications of pregnancy, 22 had sludged blood.

Vessel Walls of Human Patients

Almost all the known types of vessel wall pathology visible *in vivo* have been seen in this study of human patients: arterioles both temporarily and permanently plugged with masses of sludge, and, in some, short, spindle-shaped bulges (aneurysms) of arterioles (*45*).

The Clarks (*6*) arranged a series of pathologic reaction states of capillaries and small veins in terms of increasing degrees of response to increasing degrees of experimental injury, which permits classification of many of our observations in terms of the damage already done the vascular system rather than in terms of the patient's diagnosis. Following their classification, we have observed (a) white cells rolling along vessel linings; (b) white cells sticking, sometimes for hours; (c) white cells in layers (particularly prominent in the 3 leukemic patients, who also had circulating masses of agglutinated white cells); (d) weakened, dilated, bulged, sacculated, rapidly leaking capillaries and postcapillary venules; (According to the Clarks, and our experience is in agreement, the above stages of individual capillary and small vein wall injury are reversible to normal.) (e) true stasis, *i.e.* vessels which had been leaking rapidly, packed with red cells and/or masses of agglutinated red cells; (f) scattered red cells; and (g) small hemorrhages outside vessels which are evidences of high previous porosity or rupture of vessel walls.

Further, in many patients large areas of the conjunctival vascular system, arterioles, capillaries, and veins had been so tightly constricted that no red cells were visible or passed through, sometimes for hours. This can frequently be seen in white patients who have marked general pallor and was conspicuous in every one of 10 consecutive patients who had far-advanced pulmonary tuberculosis.

The arterial blood pressure of many of these patients was taken. In all those listed it was within normal range or above. Further, these did not show evidences of increased venous pressure. Hence, the slow passage of this sludged blood through open vessels was directly due to the sizes and rigidities of the masses, not to increased venous pressure, failing venous return, or cardiac failure.

These patients have been studied as a part of a general survey designed to find the extent of the phenomenon of intravascular agglutination of the blood. This list includes all patients in similar lists published previously (*25*). The patients in the lists are unselected—that is, no attempts have been made to keep from studying patients with any particular disease, and every patient seen who had any particular diagnosis is listed. Sludged blood has been observed in men and women, white and colored people, and persons of all ages.

Thus far, completely unagglutinated blood has been found only in strictly healthy animals and men. Mild degrees of intravascular agglutination have been seen in many laboratory workers, students, and colleagues in the Chicago area, where sinusitis of various degrees of severity and other afflictions of the upper respiratory system are endemic. The more severe degrees of intravascular agglutination have been exhibited only in animals during controlled experiments and in persons who were sufficiently ill to have placed themselves under the care of physicians. No severely ill person has yet been seen who did not have intravascular agglutination of the blood and visibly pathologic vessel walls. The survey is, of course, still in progress and should be extended as rapidly as skilled observers can be trained and opportunities made available. The ultimate survey obviously should include all the diseases and pathologic conditions of other vertebrates, including those of food fish, birds and poultry, household pets, laboratory animals, and all the mammals on which people depend for food, clothing, transportation, and the commercial production of the vaccines and therapeutic sera, as well as all the other diseases of humans.

Since 1852, when Coccius (*8*) published microscopic observations of agglutinated blood in living human patients, sludged blood has been seen or demonstrated in living animals and in human patients and some of its results observed *in vitro* or in histological sections by many investigators (*9, 12, 13, 19, 21, 23–27, 33, 35, 36, 39, 45, 46, 52*). Since Landsteiner's (*32*) demonstration of the human blood groups, microscopic study of phenomena associated with, or resulting in, agglutination of blood cells on slides and macroscopic studies in test tubes have been in continuous use in research laboratories and are now a standard part of the blood-matching techniques in all the hospitals of the world. As a result of such studies, there is an immense immunological literature describing and analyzing *in vitro* agglutinations (*48*).

Further, as a part of the classical investigations by which Robin Fahraeus (*9*) initiated the well-known erythrocyte sedimentation-rate test, he and his student, Ploman, clearly demonstrated by three separate methods that there is increased aggregation of circulating red cells within living human patients. Fahraeus' work is sharply relevant to subsequent discussions in this paper, for it forms a major connecting link between (a) the humoral pathology of the ancients, which dominated all of medicine from Hippocrates to the beginning of the cellular pathology of Virchow, (b) a large and continually growing body of knowledge about the composition and physical behavior of blood drawn from different classes of patients, and (c) the whole subject of intravascular agglutination of the circulating blood.

By means of *in vitro* studies Fahraeus showed that the increased sedimentation rates of the red cells of blood drawn from human patients were due to alterations in the chemistry of the plasma rather than to detectable changes in the blood cells themselves, and he made the first direct contributions to the understanding of the chemical changes in plasma which are associated with, and can initiate, increased *in vitro* sedimentation rates.

After a great many *in vivo* observations, Fahraeus deduced and carefully pointed out that (a) "the gas exchange between the corpuscles on the one hand, and the tissues and the alveolar air on the other, takes place via the plasma. As the aggregation of the corpuscles reduces the surface between the corpuscles and the plasma we must a priori conclude that it affects the gas exchange of the corpuscles in an unfavorable manner"; (b) agglutinated red cell masses could be expected to act as minute embolae, *i.e.* be carried into and plug small arterioles and capillaries, and multiple minute embolae are found at autopsy following many diseases; (c) reduced suspension stability of the blood must "play an important part in the genesis of thrombi—as well as concerning the red parts of the mixed great thrombi in the larger vessels as with regard to certain kinds of hyaline thrombi of the capillaries, which according to the statements of the literature are composed of fused red corpuscles and which especially characterize the changes of the bodily organs in eclampsia."

As a result of Fahraeus' *in vitro* investigations, the red cell sedimentation-rate test has become a standard part of clinical medicine and is in use in all hospitals and by nearly all practicing physicians throughout the world; in consequence, significant alterations of the rates of settling of erythrocytes have been found in blood from patients having many different diagnoses.

There has, however, been no rigorous, systematic search for all the biological, physical, and chemical etiologic agents capable of initiating intravascular agglutination of the blood or for all the chains of specific chemical and/or immunological reactions which can and do initiate *in vivo* agglutination; nor have there been systematic attempts to correlate observed and measured effects of intravascular agglutination with the signs and symptoms presented by sick people or animals, to determine the role of intravascular agglutination in the development of the lesions observed at autopsy, or to determine the kinds, degrees, and rates of damage this set of mechanisms can do to living animals and men.

How Sludged Blood Damages the Body

The concepts presented below were developed over a 7-year period, partly by comparing many observations of the agglutinated blood and damaged leaking vessel walls of diagnosed sick persons with those of the unagglutinated blood and intact vessel walls of healthy animals and men, partly by almost painless experiments upon unanesthetized, unoperated, healthy adult human volunteers, but most of all by completely indispensable, sometimes almost daily, laboratory experiments upon carefully anesthetized amphibians and mammals, including cats, dogs, and rhesus monkeys.

I. The resistance of sludged blood to its own passage through the bottlenecks of the circulatory system forcibly reduces the rates of blood flow through all the open vessels of the body.

II. Agglutinated red cells are ingested and destroyed in the phagocytic cells of liver and spleen.

III. There is settling and sedimenting of masses of agglutinated blood cells out of the moving blood plasma during life.

IV. Various degrees of reduction in circulating blood volume caused by I and II, above, initiate intermittent, prolonged, controlled shutting off of the arterioles of a selected series of tissues and organs.

Each of these categories has its own set of associated phenomena and known and probable consequences.

There are many different kinds of blood sludges, and the known and probable kinds of injury, degrees of these, and the rates at which any particular sludge damages an animal or man, depend to a great extent upon two sets of factors: (a) the as yet largely unknown chemical composition of the material or materials which hold blood cells together in wads, and (b) the easily observable physical characteristics of the masses of which that particular circulating sludge is composed.

A very simple sludge is one in which all the red cells are in masses, all masses are approximately the same size when they are in vessels which do not compress them, every mass is sufficiently cohesive internally so that it does not break up as it passes through the peripheral arteriole-capillary-venule bottlenecks, and all masses passing through any one bottleneck are compressed and elongated to an equal degree. By definition we are calling these masses which do not break up as they pass through the bottlenecks the "basic masses" of a sludge, usually abbreviated to "the basics." If we call the resistance of a mass to distortion the "rigidity" of the mass, then the sludge delineated above would be described as homogeneous—one with no free red cells, all basics having the same size and rigidity.

In addition, there are mixed sludges of many kinds: those in which free, unagglutinated red cells are also present; those in which several sizes of basic masses are simultaneously present; those in which the largest basic masses continually act as temporary embolae, *i.e.* temporarily plug each and every arteriole they enter. The concentration of such large masses per cubic centimeter of blood determines, of course, the frequency with which every terminal arteriole of the body is temporarily plugged. The time during which any arteriole is temporarily plugged, and the tissue it supplies receives no blood, often depends upon the rate at which the mass distorts to a spindle narrow enough to pass through the bottleneck, i.e. probably on the thixotropic properties of the mass (*40*). In addition, the plugged arteriole sometimes goes through slow, rhythmical contractions which may or may not compress the mass to a spindle.

There are sludges in which most basics are small, but larger masses come along at short or longer intervals, each permanently plugging whichever arteriole it enters. The damage done by these permanent plugs depends, of course, upon their numbers, their concentrations in blood at any one time, the particular tissues they happen to enter, and the summations of the lengths of time such masses enter small, isolated parts of organs. Such masses can, in relatively low concentrations, be utterly devastating over a period of a few weeks, months, or years. One young woman referred to us from a psychiatric division because she had a slightly elevated red cell sedimentation rate in addition to her "functional" psychological disturbances had 8 small permanent plugs in the terminal arterioles of the bulbar conjunctiva of one side of one eye. They were in different stages of the familiar hemoglobin chemical disintegration color series. Every once in a while a slightly smaller mass came along, temporarily plugged a vessel, and passed on again. Two weeks later the patient had three more similar permanent embolae of terminal conjunctival arterioles. From the branching pattern of the aorta and the great arteries to the head, and the fact that the blood going to the eye comes directly from these, one cannot doubt that this woman's whole central nervous system was slowly showered with permanent plugs, each of which destroyed a small volume of irreplaceable nerve cells. When one considers the parallelism between the known effects on normal persons of breathing slowly decreasing concentrations of oxygen (cerebral effects of anoxia), the slightly to greatly increased irritability, the euphoric tendency to laugh uproariously at meaningless trivia, the dull-witted phases, the compulsive behavior at times, and the comatose condition as the anoxia approaches the lethal stage, and similar phases of some of the symptom complexes studied in mental hospitals, it is obvious that several groups of psychiatric patients now need to be studied to determine the role which sludge is playing or has played in their pathologic physiology. Osler himself pointed out that psychic disturbances can and do follow infectious diseases (*43*).

There are sludges composed of masses which repel each other slightly when they are in venules and sludges in which the basic masses come together slowly or rapidly, sometimes from relatively long distances, whenever the vein blood slows down or temporarily stops. These agglomerates we have been calling "charge aggregates," because the basics obviously exert force on each other from a distance.

There are sludges in which the masses, both basics and aggregates, are very sticky and hold together with various degrees of tenacity, as can be seen where streams of blood come together in small veins, setting up "couples" of force which produce torques tending to pull such masses apart. There are also sludges in which the masses seem coated with glassy, hard materials and display no tendency to adhere to each other.

There are sludges in which the masses are bright red, in which case it must be presumed that little, if any, material is between and around the red cells holding them together; and there are still other sludges in which the masses are pale pink and, when they bump each other, behave as though a transparent invisible layer was around the red cells in each mass extending beyond the red cells.

1. All the sludges in which the masses are large and rigid enough to resist passage through the bottlenecks of the circulating system forcibly cause reduced rates of flow through all open vessels and thereby continually act toward reducing the rates of supply of oxygen to endothelium, initiating and maintaining endothelial anoxia and its consequent inevitable, well-known permeability of the endothelium to blood plasma proteins (*28–31*). This initiates continuous loss of fluid from, and continuous hemoconcentration of, the passing blood and, if the lost fluid is not rapidly removed by lymphatics, edema of the surrounding tissues. Monkeys with the stiff Stage III Knowlesi malaria sludge often die mainly from this series of effects. This has been carefully recorded in motion pictures (*29*). When these effects of forcibly reduced flow rates are of sufficient magnitude in the vessels of the conjunctiva of ambulatory patients, the patients almost always have grossly visible edema of the feet and ankles when they stand or walk for a time. This is particularly noticeable in patients with rheumatoid arthritis.

In each patient in which these sludge factors are present, they may, as far as we now know, be expected to operate in addition to any other known factors which may be increasing the rates of fluid loss through endothelium. No human patient whom we have studied who had grossly visible edema during bed rest has failed to have large semirigid masses, visibly slowed rates of blood flow through the conjunctival vessels, different degrees of plasma loss through the walls of these vessels and of microscopically visible hemoconcentration, conjunctival edema, etc. As is well known, many human patients have various degrees of unexplainable edema, particularly of the ankles when ambulant, continually or for shorter or longer periods, for years. These can now be examined for sludges and their detectable effects.

In view of the recent excellent studies of O'Neill (*42*) on the anatomy and physiology of the small vessels in the walls of large vessels (the vasa vasorum) which are necessary to nourish the tissues of the larger ones, and the role which stopping the blood flow through these small vessels plays in the damage of the lining of the large vessel, it is necessary to examine the possible roles of the sludges, which must forcibly decrease the rates of flow of blood through these small vasa vasorum, in initiating those pathologic histological changes found in human beings with arteriosclerotic disease, etc.

When all the masses of a relatively homogeneous sludge are sufficiently large and rigid, they resist passage through the peripheral vascular beds enough to cause death in a relatively short time, sometimes in experimental animals within 3 to 6 or, at most, 12 hours. Many of the details of this kind of death in monkeys have been carefully described and recorded in motion pictures taken through microscopes (*29*). Untreated, unanesthetized, unoperated monkeys with stiffly agglutinated Stage III Knowlesi malaria blood go into a slowly deepening comatose condition ending in deep coma before death. The heavily sludged blood of these animals could be studied after they were in coma in the inner surface of the gently reflected eyelid. In a number of deeply comatose human hospital patients examined by us the blood has also been agglutinated into large, pasty, sticky wads moving very slowly through rapidly leaking vessels (*7*). One such patient had a slightly elevated arterial blood pressure. Hence, the slow passage of his agglutinated blood was due to its mechanical condition rather than to failing venous return or cardiac failure. Heavily sludged blood has also been found in accidentally ill, unanesthetized, comatose rabbits and cats. Hence, it is now necessary to examine adequate numbers of cases of all the diseases of lower vertebrates, as well as of men, which can have a comatose condition as a temporary or terminal part of their pathologic physiology. Whenever large, rigid, slowly moving masses are found, drugs can easily be tested to find some which will cause or permit disintegration of the masses (*29*). When sludges are not present, experiments can be devised to find other, as yet perhaps unknown, causes of comatose conditions.

II. The rapid ingestion of masses of agglutinated blood cells by the phagocytes of the spleen and liver probably is a major factor in the initiation and maintenance of many classes of human anemias. This subject is now ready for rigorous investigation in the postoperative and postburn and so-called convalescent anemias. This factor may also be operating in many of the more specifically named and diagnosed anemias.

The subject of selective phagocytosis of particles from the circulating blood has been under rigorous investigation in our laboratory for some time (*27*). In frogs injected with India ink, each injected particle immediately receives a coating of a visible sticky material, probably protein. Monkeys in Stage II of Knowlesi malaria have a sticky coating between and around those red cells which contain malaria parasites. This coating material holds the parasitized red cells together in small, sticky clumps. In both the above situations the coating material, together with the ink or the parasitized red cells within it, has been microscopically observed to be instantly ingested upon contact with any one of the phagocytic cells lining the sinusoids of the liver (*27*), while uncoated, normal, naked, unagglutinated red cells have been completely ignored by these stationary phagocytes. In one monkey in Stage II of Knowlesi malaria, the parasite count fell from 46 to 23 per cent in three hours, which accessory experiments have shown can occur only by selective phagocytosis of coated clumps of parasitized red cells from the circulating blood by the phagocytes of the spleen, liver, or bone marrow. Depending upon the numbers of new red cells one assumes that this monkey might have made during that three-hour period, this experiment may be interpreted as demonstrating that the phagocytes of this monkey ingested and destroyed from one-fourth to one-third of all the animal's circulating red cells in three hours—the maximum rate of phagocytosis of coated blood cells thus far observed. Present experimental evidence does not permit quantitative estimates of the rates at which the phagocytes of these three organs can selectively remove clumps of coated, or perhaps even uncoated, agglutinated red cells from the blood stream. There is the further problem of attempting to find which kinds of masses are ingestible, which not, and what factors limit the rates of ingestion during any particular set of pathologic processes (*27*).

Whenever these phagocytes ingest protein-coated red cell masses, each ingestion must remove a finite amount of protein from the circulating blood. The rapid ingestion of large numbers of red cell masses, each jacketed with finite amounts of protein, may be a major factor in the protein depletions which occur in many human hospital patients (*27*). If such jacketed masses contained specific immune proteins when phagocytized, this conceivably could waste large amounts of these exceedingly precious substances (*4*). If viruses attach to red cells *in vivo*, as Hirst (*17*) has found them to do *in vitro*, the ingestion of coated "red cell plus virus complexes" could be an important part of the defense against these organisms.

One limiting factor which would seem to prevent the phagocytosis of agglutinated blood cells from running an animal or man into hemorrhagic shock is the fact that the phagocytes which remove these masses from the blood are in the blood reservoirs, spleen and liver, and that with progressively decreasing blood volume the vasomotor system empties these organs and then sharply reduces the blood flow into them (*27*).

III. In rhesus monkeys with malaria and in traumatized frogs the masses of agglutinated red cells tend to settle out of the columns of moving blood mostly in those vessels which are horizontal or nearly so and particularly in those nearly horizontal vessels in which the blood is running slightly uphill. This *in vivo* sedimentation of blood cell masses is now being actively investigated because the sedimentation and subsequent cementing together of large numbers of stationary agglutinated masses probably is a major factor in the formation of many venous thrombi (cf. *5*, *10*, *18*, *20*, *34*, *37*, *41*, *47*, *52*, *53*).

Frequently in human beings after operations or during infectious diseases (*5*) large venous thrombi form in the big veins of the legs. These may be of the diameter of a person's thumb and several inches long or more. Later, parts or all of such big masses break loose, pass up into the right heart, and enter the big arteries going to the lungs. Small masses plug small pulmonary arteries, causing pulmonary infarcts of various sizes. Large masses may fill the right heart or completely plug the pulmonary artery, causing instant death. This is an even more common cause of human death than had been suspected until recently (*5*).

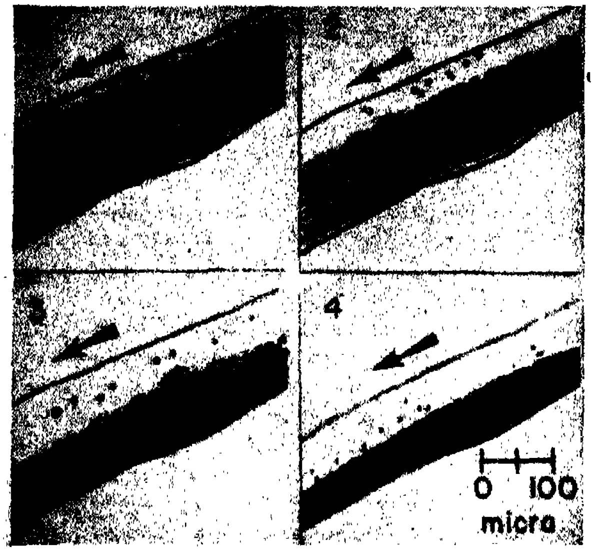

FIG. 1. Small frog mesenteric vein viewed from the side as sticky red cells and red cell aggregates slowly settle in moving blood. In 4 the masses have become cemented tightly together, making a small, lightly attached thrombus.

By suspending a fan-shaped loop of intestinal mesentery of a frog in the vertical plane and sending a beam of light through the membrane into the objective of a horizontal microscope, it is possible to view the side of all the vessels in the mesentery and watch the effects of gravity on the masses of agglutinated cells in the moving blood of all these vessels. The operation must be done without losing any blood from the frog (*27*). The trauma caused by the laparotomy initiates formation of adequate amounts of sludge for study in this preparation. The masses of sludge passing through the vessels begin to settle in every vessel which is horizontal or nearly horizontal when certain very definite physiological and physical conditions are provided. The masses must be heavier than the fluid, and the rate of flow in the nearly horizontal vessels must become slow enough so that masses cannot be carried in suspension. The resistance of the sludge to passage through the bottlenecks frequently provides sufficient reduction in flow rates. There is probably a critical speed for each size of vessel above which the red cell masses are rolled over and over and up into the axial stream; below this critical rate of flow the masses settle, the largest first. Once this process begins, the bottom layer of masses stays relatively still, and the upper layers may roll along rather slowly. Thus, the effective cross-sectional area of the vessel changes from something which approximates a circle to something which approximates the upper two-thirds or one-half of a circle. In some preparations in frogs, the masses of settled agglutinated red cells remained free from each other even when packed tightly together for an hour or two. In other preparations those masses packed together in the bottom of a vessel slowly became cemented together into long, gelatinous masses (Fig. 1). The masses settle more rapidly if the animal has a low rather than a high red cell count. This is in strict agreement with the fact that blood cell masses sediment very rapidly *in vitro* in blood with low red cell counts. The rates of flow of blood through the frog mesentery vessels can be decreased by giving drugs which decrease the animal's rate of heart beat. After a hemorrhage a frog shuts off the arterioles in many tissues (*27*). The rates of flow in small veins are thereby sharply decreased, in addition to the slowed flow already forcibly produced by the resistance of the sludge to its own passage through the bottlenecks. In animals in this condition the rates of settling of agglutinated masses in horizontal vessels are the fastest we have seen.

From the simple experiments described above and simple physical principles, it seems necessary to suspect that in many, and perhaps all, pathologic conditions in which blood cells are agglutinated, the masses tend to settle out of the moving blood stream and be deposited upon the bottom of almost every horizontal vessel of the body. Whether these masses stick to each other should depend upon their charge, degrees of stickiness, etc. Whether the whole long mass sticks to the vessel wall, or a layer of white cells on the vessel wall, must depend upon their current surface characteristics (*6*, *42*).

Such simple experiments with thin vertical tissue and horizontal microscope, and variations of them, which can be easily made using mammals with defined pathologic conditions, should make it an easy matter to determine (a) all the circumstances under which the masses will settle in the circulating blood; (b) the conditions under which they will become cemented together into a thrombus; and (c) the effects of blood transfusions and drugs toward preventing such settlings and thrombus formations in the horizontal vessels.

IV. Many hospital patients have had large areas of conjunctival vessels tightly closed for long periods. Some have shown other evidences of prolonged vessel spasms, e.g. cold lower legs and feet of far-advanced tuberculosis patients. One would expect that the leakage of vessels and phagocytosis of blood cell masses should reduce the blood volume. This, of course, could not be determined by red cell counts or the use of dye methods. Dye methods cannot be expected to have meaning in patients whose vessels are leaking the proteins on which the dyes attach, for the dye dilutes into tissue fluid and lymph as well as into blood. In order to see if controlled hemorrhage does initiate visible spasms of the conjunctival vessels, the blood and vessels of 34 blood donors, unanesthetized, unoperated relatives and friends of hospital patients, were studied before, during, and for 30 to 60 minutes immediately after each donated blood at the hospital blood bank. The experiment was made originally to identify and separate the mechanisms of traumatic shock, trauma without hemorrhage, in which thick sludge has always been present (*25*, *28*) from detectable effects of hemorrhage without trauma (*38*). This method permits study of the vascular responses of healthy persons following almost no trauma (one stick with a large needle) but with large, controlled hemorrhage.

When a donor had lost not less than 300 and not more than 500 cc. of blood, first one set and then another of the blood pathways made up of arteries, arterioles, capillaries, postcapillary venules, and venules of the bulbar conjunctiva began to contract tightly shut, ejecting all their contents into the venous system. By the time most persons had lost 500 cc. of blood, large areas of the conjunctiva were completely white, only a few small, open pathways remaining. One muscular man was bled 800 cc., whereupon he began to sweat profusely—a common sign of an approaching "shock" condition. He had almost no visible vessels or blood left in the conjunctiva. At no time within the first hour did any intravascular agglutination appear in response to this degree of hemorrhage (*25*, *28*). In most persons large areas of the vascular system, including the capillaries, remained tightly shut for at least 30 minutes.

This series indicates that decreased blood volume is *alone* a sufficient stimulus, when inhibitions and counterstimuli are not present, to initiate prolonged contractions of a variety of small human vessels and that the tissues they nourish may, in consequence, go without oxygen, glucose, etc. for considerable periods (*3*, *11*, *15*, *27*, *30*, *38*, *49*, *51*).

When one considers the numbers of already observed pathologic conditions during which a sludge was present, the fact that many sludges could be expected to do at least small amounts of permanent damage to the body, the fact that these damages must be cumulative over a long period, and the pitiful mental incompetence of the prematurely senile and of many aged persons, it becomes obvious that we now need to begin to determine carefully how all the damages done to the body by sludges can summate as parts of the aging processes. In which different and overlapping combinations can the anatomical and physiological decrements caused by sludges, and readjustments to these, summate over periods of years? How rapidly can they add up over short periods? How do these factors cumulate along with other nonsludge factors in the various aging processes?

The observations, experiments, and deductions outlined above are evidence that the sludges provide a common, easily understandable set of factors whereby many diseases can and do damage the bodies of animals and man. One great hope provided by these studies is that, as we learn how to keep blood normally unagglutinated and fluid, vessel walls intact, normal red cells from being destroyed, and adequate blood volume present, many effects of other pathologic mechanisms will stand out clearly, unobscured by the sludge mechanisms. Each will, of course, then receive the undivided attention it merits. The sludges are now ready for study by all the intensive investigative methods our age affords.

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NEWS *and Notes*

Robert T. Hatt, director, Cranbrook Institute of Science, will conduct an expedition to Yucatan this month to obtain land vertebrates. The work will be under the auspices of the Institute and the Viking Fund.

Hans Albert Einstein, engineer, U. S. Department of Agriculture Soil Conservation Service, has been appointed acting associate professor of engineering, University of California.

Harold F. Blum, physiologist, National Cancer Institute, has moved from the Marine Biological Laboratory, Woods Hole, Massachusetts, to the Department of Biology, Princeton University, where he has been appointed visiting lecturer.

William Walter Greulich, professor of anatomy, Stanford University School of Medicine, and director, Brush Foundation, has returned to the United States with Mrs. Greulich after spending three months in Guam and Japan. In Guam, Prof. and Mrs. Greulich completed a survey of the physical and nutritional status of Guamanian school children in collaboration with the Public Health Section, Naval Government, and as part of the Coordinated Investigation of Micronesian Anthropology, being conducted under the auspices of the Navy Department and the Pacific Science Board of the National Research Council. In Japan, they made a preliminary roentgenological and anthropometric study of children in Hiroshima and Nagasaki who were exposed to the irradiation from the atomic bombs. Similar observations were made also in Kure and Sasebo, whose populations resemble those of Hiroshima and Nagasaki, but which escaped bombing. This study was made for the Committee on Atomic Casualties, National Research Council, and conducted under the auspices of the Japanese National Institute of Health and with the cooperation of the Section of Public Health and Welfare of SCAP. The object of the study was to obtain information on which plans for a long-term investigation of the growth and development of the Japanese children in those areas can be based.

Otto Halpern, recently visiting professor of theoretical physics, Columbia University, has been appointed professor of theoretical physics, University of Southern California, where, in addition to graduate teaching, he will continue his theoretical research on neutron scattering and problems of interaction between matter and radiation.

Othmar F. Gorlup, chief, Allotment and Requirement Branch, Medical Personnel Division, Office of the Air Surgeon, has been appointed the first chief of the recently created Medical Service Corps, Army Medical Department, with the rank of full Colonel.

Eliot C. Williams, Jr., who for the past 7 years has been associated with the Chicago Academy of Sciences, where he served as assistant director, has been appointed assistant professor of biology, Roosevelt College of Chicago.

Barry Commoner has been appointed associate professor of plant physiology, Henry Shaw School of Botany, Washington University, St. Louis.

Frances Carlin, formerly assistant professor of foods and nutrition, Hood College, Frederick, Maryland, has been appointed associate professor of foods and nutrition, Iowa State College.

E. M. Cralley, formerly associate professor of plant pathology, University of Arkansas, will return to the University in February 1948 as full professor. Dr. Cralley is now in Korea, where he is in charge of rice disease research for the military government.

George Neville Jones, associate professor, Department of Botany, University of Illinois, has been named associate editor of the *American Midland Naturalist* to represent the field of plant taxonomy.

Irvin E. Liener, First Lieutenant, Quartermaster Corps, U. S. Army, has been appointed to the staff of the Rations Planning Office, Quartermaster Food and Container Institute for the Armed Forces, Chicago.

Edward B. Ellis, formerly of Memorial Hospital, New York, has been appointed to the staff of the Technicon Company, 215 East 149th Street, New York.

Gerald G. Gross, former science writer on the *Washington Post*, is now editor of *Washington Report on the Medical Sciences*, a weekly newsletter with excellent coverage of happenings of a medical nature in and around Washington. Published every Saturday, it is timed for arrival at any point in the country on the following Monday. The subscription rate is $50 per year. A trial four-month subscription may be taken at the special rate of $15. Offices of *Washington Report* are at 1713 K Street, N. W., Washington 6, D. C.

Shields Warren, a pathologist at New England Deaconess Hospital and assistant professor of pathology, Harvard University, has been named interim director of AEC's new Division of Biology and Medicine (*Science*, September 26, p. 285). Dr. Warren will be on a half-time basis pending appointment of a permanent director.

Horace M. Miner, associate professor, Department of Sociology, University of Michigan, has also been appointed associate professor in the Department of Anthropology.

Peter A. Bungart, preparator and collector of fossil fish, Department of Paleontology, Cleveland Museum of Natural History, has retired after 24 years with the Museum. **Harry C. Oberholser,** curator of Ornithology at the Museum, has also retired.

P. A. Wells, general secretary, Society of Dyers and Colourists, Bradford, England, has been appointed director of education, International Wool Secretariat, London.

Grover L. Bridger, chief, Process Development Division, Tennessee Valley Authority, has been appointed professor and head, Department of Chemical Engineering, Iowa State College, effective November 14. **O. R. Sweeney,** head of the Department since 1920, is retiring from administrative duties but will continue as professor of chemical engineering.

J. M. Schopf, formerly paleobotanist, U. S. Bureau of Mines, Central Experiment Station, Pittsburgh, has recently returned from the Union of South Africa, where he was engaged in petrographic study of coal under the auspices of the South African Council for Scientific and Industrial Research in cooperation with the South African Geological Survey and the Fuel Research Institute. Since returning, Dr. Schopf has been appointed to the U. S. Geological Survey, Section of Paleontology and Stratigraphy, with headquarters at 330 U. S. National Museum, Washington, D. C., where he will continue studies dealing with the constitution and microfossils of coal.

Max Lauffer, professor of physics, University of Pittsburgh, has been appointed chairman of the Executive Committee of the Department of Physics for the current academic year. **David Halliday** will serve as executive secretary for the Department.

Russell W. Cumley, medical editor, Abbott Research Laboratories, North Chicago, has been appointed to the recently created position of medical editor and director of publications of the M. D. Anderson Hospital for Cancer Research.

Joseph P. Fulton, University of Illinois, has been appointed assistant professor in the Department of Plant Pathology, University of Arkansas, where, in addition to teaching, he will conduct research on vegetable crop diseases.

Visitors to U. S.

Gregg M. Sinclair, president, University of Hawaii, recently visited the University of Texas Medical Branch, Galveston, to survey current educational and research methods in medicine.

H. A. Hyde, keeper of the Department of Botany, National Museum of Wales, Cardiff, summarized his studies on atmospheric pollen in the British Isles at the seminar of the Department of Botany, University of Minnesota, October 2. Mr. Hyde is visiting this country under the auspices of the Welsh National School of Medicine, Cardiff.

B. C. J. G. Knight, Department of Biochemistry, Wellcome Physiological Research Laboratories, Beckenham, Kent, England, will deliver the second Harvey Lecture of the current series at the New York Academy of Medicine on November 20. Dr. Knight will speak on "Bacterial Chemistry and Evolution."

Grants and Awards

The John and Mary R. Markle Foundation has embarked upon a new program to relieve the shortage of instructors in medical schools and to provide more trained investigators for medical research. Accordingly, the Foundation is offering post-fellowship grants to young scientists with the necessary training to hold regular faculty appointments and to conduct original research. Candidates, to be limited to young men and women with a particularly strong interest in research and teaching in any of the clinical or preclinical sciences or in the sciences basic to medicine, will be recommended for the grants by the medical schools, and the final choice of "Scholars in Medical Science" will be made on the basis of these recommendations and those of regional committees appointed by the Foundation. Grants of $25,000, payable to the cooperating medical school at the rate of $5,000 annually for a 5-year period toward the support of each successful candidate or his research, or both, will be available beginning with the academic year 1948–49. No fixed number of Scholars will be appointed in any one year, but it is expected that about 50 will receive appointments during the 5-year period. If the plan is successful, $1,250,000 will be appropriated to the schools by 1953. The program is the result of a survey of medical research and education made recently by the Foundation, which indicated that although various forms of financial aid are available to the student in the course of his scientific training and to the scientist once his name is made, there are few sources of help at the start of a career in academic medicine. Those interested may secure further details of the plan from the dean of the accredited medical school of their preference.

The American Pharmaceutical Association is now receiving nominations for the Iodine Educational Bureau Award ($1,000 and a diploma) which recognizes outstanding research in the chemistry and pharmacy of iodine and its compounds as applied in pharmacy or medicine. Any member of the Association may propose a nominee by submitting specific identification of the work to be considered in the competition, a biographical sketch of the nominee including date of birth, and a list of his publications. Eight such copies must be submitted to the secretary of the Association, Robert P. Fischelis, 2215 Constitution Avenue, N.W., Washington 7, D. C., before January 1. The nominee must be a resident of the United States or Canada, must have accomplished outstanding research in the chemistry or pharmacy of iodine and its compounds as applied in pharmacy or medicine, including diagnostic use, and must have been actively engaged in, have completed, or have published a report upon the line of investigation for which the award is made, and he must not have been engaged in research under the sponsorship of the Iodine Educational Bureau, Inc., during the last two years.

George W. Vinal, chief of the Electrochemistry Section, National Bureau of Standards, has been awarded the Certificate of Commendation by the Bureau of Ships of the Navy Department for his outstanding service to the Navy during the war in development of new types of batteries and for his work as secretary of the Joint Army-Navy Battery Advisory Committee.

Edward R. Schwarz, head, Textile Division, Massachusetts Institute of Technology, was awarded the Olney Medal for outstanding achievement in the field of textile chemistry at the annual convention of the American Association of Textile Chemists and Colorists, held in Chicago October 23–25.

W. A. Pennington, chief chemist and metallurgist, Carrier Corporation, Syracuse, New York, was presented the Henry Marion Howe Medal for 1947 by the American Society for Metals at its annual banquet held October 23 in conjunction with the National Metal Congress and Exposition. The award is made annually to the author or authors of the technical paper of highest merit published in the annual *Transactions* of the Society. The subject of Dr. Pennington's paper was "A Mechanism of the Surface Decarburization of Steel."

Robert Jemison van de Graaff, Massachusetts Institute of Technology, has been awarded the 24th Duddell Medal of the Physical Society, London, in recognition of the invention and development of his high-voltage electrostatic generator. The Duddell Medal is awarded annually, without restriction as to nationality or to Fellowship in the Society, to persons who have contributed to advancement and knowledge by the invention or design of scientific instruments or by the discovery of materials used in their construction.

Frederick H. Verhoeff, professor emeritus of ophthalmic research, Harvard Medical School, and consulting chief of ophthalmology, Massachusetts Eye and Ear Infirmary, received the Leslie Dana Gold Medal presented by the American Academy of Ophthalmology and Otolaryngology, October 16, in recognition of outstanding achievements in the prevention of blindness and the conservation of vision.

Fellowships

The Lalor Foundation Fellowship Program at the Marine Biological Laboratory, inaugurated in 1947, will continue in 1948. Postdoctoral summer fellowships in the fields of biophysics, biochemistry, and physiological chemistry will be available. The fellowships are designed primarily to aid promising young investigators who can make maximum use of the facilities and opportunities provided at the Marine Biological Laboratory. In addition to laboratory facilities, the grants are intended to cover approximately the living expenses of the investigators at Woods Hole and necessary traveling expenses to and from Woods Hole. The committee administering the fellowships consists of Eric Ball, Kenneth Cole, Charles Packard, A. K. Parpart, and C. W. Metz (chairman). Inquiries and applications should be addressed to the director of the Marine Biological Laboratory, Woods Hole, Massachusetts, and applications should be received by December 31, 1947.

Radcliffe College has announced the availability of the Helen Putnam Fellowship for Advanced Research, which carries a stipend of $2,000 for 11 months beginning October 1, 1948, with a possibility of renewal for a similar period. Each Fellow will be assigned room and board at cost in one of the Radcliffe graduate houses and will be expected to be in residence during the tenure of the fellowship; she will also be provided with all normal laboratory facilities. There are no age restrictions for this fellowship, but in general the Committee on Award will limit its choice to mature women who hold their doctorates or equivalent qualifications. Appointments will be limited to those candidates who can submit a plan of research that is already under way in the fields of genetics or mental health, broadly defined. Application forms, which must be submitted before April 1, 1948, may be obtained from the Committee on the Helen Putnam Fellowship for Advanced Research, Radcliffe College, Cambridge 38, Massachusetts.

The Mellon Institute has announced the establishment there of a comprehensive multiple research fellowship on orthopedic appliances by the Sarah Mellon Scaife Foundation of Pittsburgh. Under the guidance of orthopedists and with the cooperation of both leading organizations in the field and manufacturers of orthopedic appliances, broad scientific investigation and development relating to such appliances will be conducted. Particular attention will be given to problems of mechanical design, improvements in materials of construction, and methods of fitting braces and similar orthopedic devices. **John L. Young**, research specialist in metallurgy and mechanical engineering, who will head the program as Senior Fellow, will be assisted by **Eugene F. Murphy**, staff engineer, Committee on Artificial Limbs, National Research Council, as Advisory Fellow, and several research assistants. The medical advisory committee of the fellowship is under the chairmanship of Paul B. Steele, professor and head, Department of Orthopedic Surgery, School of Medicine, University of Pittsburgh, who will be assisted by John A. Heberling, associate professor of orthopedic surgery, and Carl C. Yount, assistant professor of orthopedic surgery, both of the University of Pittsburgh.

Industrial Laboratories

William W. Hartman, assistant superintendent, Synthetic Chemistry Department, Eastman Kodak Company, has been appointed superintendent of that Department.

George H. Schneller, formerly head of pharmaceutical research, Wm. S. Merrell Company, Cincinnati, has been appointed director of pharmaceutical application in the Pharmaceutical Department, Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey.

Alton Bryant, who recently obtained his Bachelor's degree in bacteriology from the University of Kentucky, has joined the Bacteriology Laboratories of the Wm. S. Merrell Company, Cincinnati.

A course in X-Ray Diffraction and Spectrometry will be given by the North American Philips Company, Inc., November 17–21, at its New York offices, 100 East 42nd Street, to acquaint industrialists, technicians, and research specialists with fundamentals of X-ray diffraction and its applications. Lectures will be given daily, followed by discussion periods and laboratory work. Guest speakers will include: M. J. Buerger and John Norton, of Massachusetts Institute of Technology; Charles Barrett, University of Chicago; I. Fankuchen, Brooklyn Polytechnic Institute; Herbert Friedman, Naval Research Laboratory; and William Parrish, Philips Laboratories, Inc. Sessions will begin at 9:30 A.M. and end at 5:00 P.M. A fee of $50 is required of all taking the course except the Philips diffraction equipment owners.

The Nucleonics Project of General Electric Company, which consists of work on atomic energy for the U. S. Atomic Energy Commission, now has as its administrator **R. S. Neblett,** who has been manager of G-E's Federal and Marine Divisions. The G-E Nucleonics Committee, which has administered the Company's activities in this field for the past year, has announced that responsibility for contractual administration and negotiations in connection with the Project is transferred to the Chemical Department. The Committee will retain responsibility for general policies of administration and operation of the Project. Operation of the $20,000,000 Knolls Atomic Power Laboratory, now under construction by the Company for the AEC, will remain under the G-E Research Laboratory, while the Chemical Department will retain responsibility for operation of the Hanford Engineer Works near Richland, Washington.

Colleges and Universities

The 29th course of Lane Medical Lectures, which were founded in 1896 by the late Levi Cooper Lane, will be given each evening at 8:15, November 11–13 and 17–18, in Lane Hall, Stanford University School of Medicine, Sacramento Street, near Webster, San Francisco, California. The lectures will be delivered by Wilder G. Penfield, professor of neurology and neurosurgery, McGill University, and director, Montreal Neurological Institute, on the subject, "Physiological Observations on the Cerebral Cortex of Man." The 5 individual lectures on this topic will include: "Introduction, With Observations on Hearing and Vision," "Sensorimotor Organization of the Cerebral Cortex," "Secondary Mechanisms of Movement, Sensation, and Speech," "Dreams, Hallucinations, and Memory," and "Cortex, Consciousness, and Cerebral Seizures." The medical profession, students, teachers, and research workers in medicine and allied sciences are cordially invited to attend.

The Academy of Natural Sciences, Philadelphia, has set up a cooperative arrangement which enables graduate students of Bryn Mawr College, Haverford College, LaSalle College, Swarthmore College, University of Pennsylvania, Temple University, and Rutgers University to study systematics as a part of their regular curriculum. **Ruth Patrick,** associate curator of Microscopy at the Academy, **Francis W. Pennell,** curator of Plants, and **H. Radclyffe Roberts,** managing director of the Academy, are in charge of the course. Emphasis will be on the principles of systematics rather than on the classification of any particular group. Cytological, serological, physiological, and statistical, as well as morphological methods will be considered. The course is given at the Academy every Saturday from 8:00 A.M. to 1:00 P.M.

Meetings

The Tennessee Academy of Science will hold its 57th annual meeting November 28–29 at the University of Tennessee, Knoxville. Paris B. Stockdale, Department of Geology and Geography, University of Tennessee, president of the Academy, will preside at the opening general session Friday morning. Sectional meetings will convene Friday afternoon under the leadership of the following chairmen: Botany, D. M. Brown, East Tennessee State College; Chemistry, Raymond Seymour, University of Chattanooga; Geology and Geography, Harry J. Klepser, University of Tennessee; Mathematics, T. C. Carson, East Tennessee State College; Zoology, C. L. Baker, Southwestern University; and the Junior Academy, Frances R. Bottom, sponsor, George Peabody College. The annual dinner will be held Friday evening, and the business session with election of officers, Saturday morning. Members wishing to submit papers at the general sessions should send titles to the program chairman, Arthur C. Cole, Department of Zoology, University of Tennessee. Those wishing to present papers at the sectional meetings should submit titles to the sectional chairmen.

The American Physiological Society will hold its regional meeting as an open symposium on "Military Physiology" at the Army Medical Department Research and Graduate School, Army Medical Center, Washington, D. C., December 4–6. Members of the Society, their associates, and students are invited to attend. At the first session, beginning at 10:30 A.M. in the Sternberg Auditorium, Army Medical Center, representatives of 9 Army, Air Force, and Navy laboratories will present the high lights of their programs in physiological research. The second day will be devoted to the presentation of research on respiratory physiology carried out with military support in 10 universities. At the last sessions, papers will be presented on physiological researches conducted in neighboring government and civilian laboratories.

The 15th annual meeting of the Association Canadienne-Française pour l'Avancement des Sciences was held October 11–13 in Montreal, Canada. Papers were presented in the Physics, Chemistry, Geology, General Biology, Entomology, Botany, Agronomy, Biogeography, and the Moral Sciences Sections. A report of two symposia on the scientific training in French Canada and on the situation of French-Canadians in scientific positions will be published shortly. The BAAS was officially represented by its president, Sir Henry Dale, and the AAAS by J. W. Bridges, professor of experimental psychology, Sir George Williams College, Montreal. Joseph Risi, professor of chemistry, Laval University, Quebec, was elected president; Léon Lortie, professor of history of science, University of Montreal, vice-president; and Lionel Lemay, professor of chemistry, University of Montreal, general secretary. The main office of the ACFAS is located at the University of Montreal, 2900 Mount-Royal Boulevard, Montreal 6, Canada.

The Hungarian Research Institute for Genetics and Plant Breeding, Budapest, has sent a request to the Committee on Aid to Geneticists Abroad, Genetics Society of America, for reprints in genetics, and particularly in plant genetics. Packages of reprints weighing not more than 4⅖ pounds (2 kilos)may be sent to Dr. Thomas P. Bogyó, Research Institute for Genetics and Plant Breeding, Hungarian Bureau of Agricultural Science, II Herman Otto út 15, Budapest, Hungary.

The American Chemical Society has chartered its second local unit outside the United States, this one being in Puerto Rico. Officers of the new section are: chairman, Fritz Fromm, professor of chemistry, College of the Sacred Heart; chairman-elect, Fernando Badrena, production engineer, Puerto Rico Phosphate and Acid Works, Inc.; and secretary-treasurer, Leonardo Igaravidez, Agricultural Experiment Station, University of Puerto Rico. Victor Rodríguez Benítez, chairman, Department of Chemistry, Agricultural Experiment Station, will represent the section on the Society's national council.

COMMENTS
by Readers

Because I believe the President, the Congress, and most scientists are in agreement on the essentials of national science legislation and administration, I venture to suggest that differences relating to the setup of the proposed Foundation and the details of its administration and operation should be settled promptly so that we may get on with the business of producing scientists and fostering research on a civilian basis. The points on which we seem to be in agreement are the following:

Freedom of research and education. It is accepted by most scientists that it would be a mistake to establish a foundation which would attempt or be tempted to select and supervise the particular projects on which scientists shall work. It is agreed generally that, given reasonable provision for accounting for the use of public funds, the institutions and the individuals within institutions selected to carry on research should be granted freedom of choice and action. This is not to say there should be no "request" research, but the emphasis should be on "free" research. The same applies to individuals granted scholarships or fellowships: once it is decided by competent authorities that they have capacity for scientific education or advanced research such as to warrant support, scholars and fellows should be free to pursue their interests in institutions and in directions of their own selection.

Civilian administration. The Army and Navy have been in a position since the war to command support for research not immediately related to military requirements, and have had the guidance of scientists tried and qualified by wartime and other experience. This effort will go forward under the new military setup with Dr. Bush as chairman of the coordinating board for the three Services. Despite the temptation, in view of the controversy over the National Science Bill, to acquiesce in continuation of an arrangement of proved efficiency, I believe none of us is yet willing to default in favor of permanent military administration. Granting the need for military research on weapons and materials, and the necessity for cooperation between military and civilian authorities, it seems to be conceded that civilian rather than military administration of most of the basic research is desirable.

Emphasis on fundamental research in universities and colleges. This proposition does not require argument in *Science*. The point that should be mentioned is that "universities and colleges" does not mean merely the big universities and colleges, nor does it mean institutions located in certain sections of the East, Middle West, and West. I have never met a scientist serving as head of a university or institution, or engaged in research or teaching, who did not say that the hothouse methods employed during the war should be greatly modified, if not abandoned, in the interest of making it possible, as soon as possible, for any college or institution, and for any individual anywhere in the country, to qualify for support. Most of the scientists I know would gladly risk a waste of funds rather than sacrifice the opportunity to build up scientific research and education throughout the country. They know that research capacity and scientific aptitude are not localized phenomena. What they oppose is provision for mandatory, arbitrary distribution of funds without reasonable reference to scientific or educational standards.

Emphasis on training personnel. This point is mentioned only to show it has not been overlooked. For several years the principal object must be to produce scientists and, particularly, teachers of science.

Utilization of both laymen and scientists in the program. There is some misunderstanding about this. It has been assumed by many that the National Science Board, under S. 526 or S. 1850 (the rival legislation), would consist only of scientists, and that the persons appointed would be heads of institutions or departments or other "big-name" men. There is no basis for these assumptions. The bills that have been seriously considered provide for the appointment of qualified laymen as well as scientists on the basis, without reference to politics, of capacity to serve and promote the interests of the Foundation. That qualified laymen should be attracted to this service is not denied, except perhaps by those few who believe that laymen having private interests are incapable of giving disinterested and effective service to a public agency.

Agreeing that it is quality of administration we are looking for, it is generally accepted that we should not insist on filling the board only with those who are able and willing to become full-time officials. Room should be left, and is left in the bills under consideration, for the appointment of present employees of the Government and for recruiting laymen as well as scientists outside the Government.

We cannot dodge the fact that there have been conflicts among us over certain features of the legislation. It is on these points that reasonable concessions should be made:

Appointment and responsibility of the director. It may be that in this respect the bill rejected by the President violates "basic principles which make for responsible government"—but I doubt it. The highly successful National Advisory Committee for Aeronautics is an agency similar in essential respects to the Foundation proposed in the rejected bill. (In the case of NACA there would be more reason for application of the "in-line" principle: NACA is an operating agency, whereas the proposed Science Foundation is precluded from conducting laboratories or pilot plants.) Likewise in the states there are departures from the principle. In New York, for example, the Commissioner of Education is appointed by, and is responsible to, the Board of Regents; I need but mention two recent incumbents—President Stoddard, of the University of Illinois, and his successor, Commissioner Spaulding—to demonstrate that successful administration is not dependent on a theory of organization.

The object is to establish a Foundation which will be vital and imaginative and liberal, not merely efficient in a bureaucratic sense. Nevertheless, those of us who were satisfied with S. 526 should be the first, perhaps, to offer a concession in view of the strong and authoritative view the other way. None of us wants to dilute or disparage the powers and responsibilities of the President; what is really desired is that the scientists represented on the board shall have a voice in the choice of the principal executive officer of the Foundation. An amendment which would give the President the power to appoint the director after receiving nominations from the board, and which would give him the power to remove the director, would substantially meet the objection to this feature of S. 526.

Status of the board. It has been said that the board described in S. 526 would consist "essentially of private citizens" who would meet only occasionally, and it is suggested that their service would be casual and perfunctory. There is no basis for this view. All of our experience demonstrates that if strong appointments are made, the members will be conscientious to the point of sacrifice—as much so, at least, as the members of any full-time commission now serving in Washington. One of the principal reasons for specifying a part-time board was to obviate the drag which, after the formative period, affects full-time commissions; to save as much as possible of the amateur spirit in the direction of the Foundation; and to attract men and women, scientists and laymen, who might be unable to devote full time to Foundation service. It is hoped the critics of S. 526 will make a concession on this point.

It has been too little stressed, I think, that in making this provision for Federal grants to institutions and individuals we shall be better satisfied if ultimate responsibility is placed on the shoulders of a selected group of our fellow citizens rather than in the hands of a full-time official. Without reflecting unfavorably on the present administration of taxpayers' money for scientific research and education, it should be borne in mind that we are proposing a vast extension of Federal assistance which, I submit, should be subject to direction and check beyond that required for the ordinary business of Government. Related to this is the belief held by many that, to minimize if not avoid political interference and criticism, the President and the Director of the Foundation should be protected against pressure for grants; an authoritative board appointed by the President should be responsible for policies and grants.

Other details. Though the President is critical of other features of S. 526, the Congress and the scientists do not seem to be involved in any serious disagreement. The provision for the interdepartmental committee should be amended to place the direction of its activities directly under the President's authority. The provisions for special commissions (except perhaps the provision for a commission on cancer research, which might serve a useful purpose in establishing a clearing and coordinating agency) seem unnecessary and should be eliminated. (BETHUEL M. WEBSTER, *15 Broad Street, New York City.*)

* * *

Work done in compression, $pdv = dW$, say, has as its counterpart a change in potential, $vdp = dW_0$; similarly for a change in thermal energy, $dQ = TdS$, and its counterpart, $SdT = dQ_0$. It is proposed to regard this dQ_0 as potential thermal energy analogous to work potential vdp and so clarify and simplify the thermodynamics of deformation.

In a previous paper (*Science*, October 4, 1946, p. 317) it was shown that the Second Law in a very simple and useful form may be directly derived from the Gibbs thermodynamic potential, $U - TS + pv$, for any body in which that potential is uniform. When energy dU (either thermal or mechanical) is added or removed,

$$(1)\qquad dU - TdS + pdv = 0$$

by the First Law; hence

$$(2)\qquad SdT = vdp,$$

the Second Law.

In other words, as the internal energy of a body is changed, whether by heat or by mechanical work, the thermal and mechanical potential energies change always by equal amounts. The "free" energies, TdS and pdv, are not equal in general, but $SdT = vdp$ ($dQ_0 = dW_0$) for every reversible process.

Free and potential energies are related through the physical properties of a body. For example, $pdv/vdp = p\beta$, where β is the compressibility defined by $dv = v\beta dp$. Similarly, $TdS/SdT = \alpha T$, where α is the thermal coefficient of expansion given by $dv = v\alpha dT$.

$$(3)\qquad \frac{pdv}{vdp} = \frac{d\log v}{d\log p} = \frac{dW}{dW_0} = \frac{dW}{dQ_0} = p\,\beta,$$

$$(4)\qquad \frac{TdS}{SdT} = \frac{d\log S}{d\log T} = \frac{dQ}{dQ_0} = \frac{dQ}{dW_0} = T\alpha,$$

$$(5)\qquad \frac{Tdp}{pdT} = \frac{TdS}{SdT} = \frac{dQ}{dW} = \frac{T\alpha}{p\beta}.$$

These sets of fundamental relations permit many kinds of transformations between variables, but adiabatic coefficients must not be confused with isothermal.

In the writer's proposed general law of deformation (see *J. Franklin Inst.*, May 1921 and December 1946),

$$(6)\qquad \frac{dy}{y} = n\frac{dt}{t} + m\frac{dp}{p} + r\frac{dT}{T},$$

the parameters n, m, r are ratios of fractional increments similar to those in (3), (4), and (5) above. If y in (6) is volume, then $m = p\beta$ and $r = T\alpha$. Hence, by (6), m is simply the ratio of the increments of free and potential mechanical energy, dW/dW_0, and r is dQ/dQ_0. The creep factor involved in n of (6) is time t times a constant having the dimension reciprocal time.

The relations discussed above are, of course, exact only in the differential form given. Some of them hold in integral form over a surprisingly wide range, but in such cases the physical processes involved must remain constant. And in the differential form (6) there is no difficulty with fractional dimensions, since the parameters are simply dimensionless ratios of fractional increments, each of which is dimensionless.

Since the increments of thermal and work potential are always equal, whether due to added heat or work, it follows that the total potentials remain equal over very wide ranges.

In deriving his radiation formula, Planck found the probability of P packets of radiation, each of energy $h\nu$, being associated with N resonating particles having an average energy E_0, introducing the assumption $Ph\nu = N E_0$, or radiation density equals mechanical energy density. Fitting this assumption to the Second Law (2) involves some interesting physical relations.

For gases, $T\alpha$ and $p\beta$ are unity; hence, in a gas all four forms of energy are present in equal amounts. For most solids and liquids these products are very small, and correspondingly large potentials are to be dealt with. (P. G. NUTTING, *3216 Oliver Street, N.W., Washington, D. C.*)

* * *

TECHNICAL PAPERS

The Remote Sustained Threshold Therapeutic Action of Streptomycin in Tuberculosis

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The use of streptomycin as a therapeutic agent in tuberculosis has posed many problems. It is believed such problems cannot be solved by human therapeutic use but, of necessity, must be founded basically in the intimate mechanisms of its actions in tuberculosis. Therefore, exacting and carefully planned animal experimentation will be required for elucidation. Although suspected of acting in the animal economy as it does in the test tube, there are many discrepancies between so simple an explanation and observed facts.

In previous communications (*1*, *2*) it was shown that streptomycin is not capable of destroying either virulent or avirulent human tubercle bacilli in the body and that maximum tolerated doses in guinea pigs (or other laboratory animals) cannot completely retard the development of the tubercle bacilli or tuberculosis following intravenous infection. However, it does exert a definite and fairly consistent partial retarding effect on the development of tuberculosis in animals in appropriate doses, and therefore must be considered an adjuvant treatment for this disease at present under certain limitations prescribed by necessary sanatorium and hospital regimes or supervision.

Streptomycin cannot be considered an inert or nontoxic therapeutic agent in itself, and therein lies the question of the appropriate, the maximum, and the most efficient dose to attain the maximum therapeutic benefit, acknowledging that it is an adjuvant agent against tuberculosis in man. On the toxicological and pathological side there is every reason to believe that those early enthusiasts who saw little detrimental effect from its use for short periods of time considered only spectacular effects in man as significant. It was noted that "early side reactions have not been alarming, and no late toxic effects have so far been observed" (*7*); or, "In this limited experience, tests of renal and hepatic function together with blood studies before and after the parenteral administration of streptomycin revealed no evidence of serious toxicity. Reactions, consisting of fever, arthralgias, and skin rashes as well as histamine-like effects, are believed to be due to impurities retained in the preparations of streptomycin employed in these studies" (*4*). A better interpretation of the toxicity, in 1946, seemed to be that "streptomycin as well as its impurities are pharmacodynamically very active compounds. A more detailed knowledge of their toxicologic properties is a matter of great importance" (*5*). Reporting more recently from studies with streptomycin administration in tuberculosis in man, the conclusion is drawn that "as streptomycin can produce potentially serious toxic reactions it is inadvisable to use the drug in the treatment of generally benign infections, such as recently acquired pulmonary tuberculosis of minimal extent" (*3*). A more strictly pathological study on normal animals (monkeys, dogs, rats, mice, chickens, and guinea pigs) indicated a toxicity of low order, but large doses produced focal necroses in the lungs in dogs, fatty metamorphosis in the kidneys of monkeys and dogs, and neurotoxic effects in dogs (*6*).

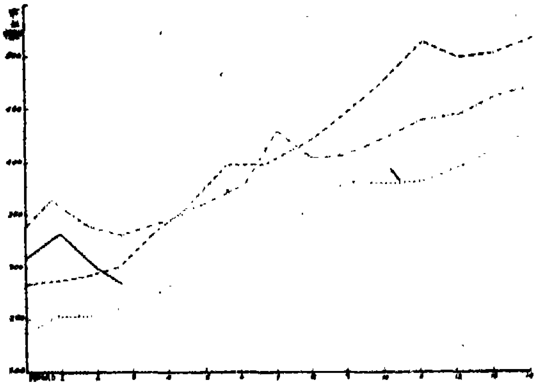

Fig. 1. Average weight chart of streptomycin-treated animals: ——— infection controls; ········· 4 daily doses; — — — 1 daily injection; — - — - — 5-day interval injection.

The following report on the effect of streptomycin in tuberculosis is not intended to be final or complete and is presented with the full recognition of a definite effect of streptomycin as a partial retardant to tuberculosis. For this presentation it is limited to the guinea pig, the animal in which this retardant effect of streptomycin was first demonstrated. The information disclosed may be valuable for the proper therapeutic use of streptomycin in man as well as extending the appropriate use of this drug, which is still limited in production and economically beyond the reach of some institutions and tuberculous individuals. It must be recognized at the outset that these results are those of a set, controlled experiment in which the bacilli were introduced into young, normal animals. Such effects of streptomycin on tuberculosis as are noted here might occur in the naturally infected and relatively immune tuberculous man far less definitely and consistently, although the significance of the dosage of streptomycin would in all probability be the same and could be applied to man without exaggeration. If we now use the two most conspicuous effects of streptomycin in tuberculosis (the prolongation of life and the retardation of the disease in the guinea pig) as a criterion, it will be possible to approximate the relative value and efficiency of different modes of treatment, comparatively speaking, with streptomycin in tuberculosis. Without elaborating upon details, the following findings with streptomycin treatment were noted, using for this study only the best, purest, and highest unit titer streptomycin obtainable at present. All the streptomycin used rated at about 1,000,000 units/gram.

In all the infections in these experiments, a highly virulent strain of human tubercle bacilli (#4008) was used, and a standard amount (1 mg.) of fine suspension was injected intravenously into the ear vein. All treatments with streptomycin were given by subcutaneous injection.

In a series of preliminary experiments in which the persistence of streptomycin effect was studied, using a sufficiently large number of controls (6) and an equal number of streptomycin-treated animals (given 25,000 units of streptomycin daily for 82–91 days and infecting intravenously one day after the last treatment), the average duration of life of the controls was 22 days compared with 29 days for the pretreated animals. When the pretreatment with a similar amount of streptomycin daily continued for only two weeks, the average duration of life of the controls was 21 days; and for animals pretreated with streptomycin, it was 22 days, which is about the same, although the spleen size was preceptibly less in the treated animals. In single injections, 50,000 units of streptomycin were not lethal, while 100,000 units were frequently fatal in our tests on normal animals.

In order to compare the results of the injection of 4 doses of streptomycin daily for a total of 25,000 units with a single injection of 25,000 units daily and 25,000 units given at 5-day intervals in a single injection, several sets of duplicate experiments were performed. Four to 6 or more guinea pigs were used in each test as well as infection control animals given only the intravenous injection of 1 mg. of virulent human tubercle bacilli in fine suspension without treatment with streptomycin. While the average duration of life of the control infected guinea pigs varied within the narrow limits of 19–21 days, that of the animals given 4 daily injections to a total of 25,000 units daily was from about 100 to about 150 days. Those given the 25,000 units at 5-day intervals, starting 6 days prior to infection and continuing throughout infection, were also alive beyond 100 days in most instances.

In these experiments it was noted that individual animals would die of a generalized tuberculosis in spite of intensive treatment with streptomycin and regardless of whether the injections were given daily or at 5-day intervals.

The appended 14-week weight graph (Fig. 1) illustrates the effects of 4 daily injections (for a total of 25,000 units) of streptomycin, one single daily injection throughout the experiment, and single injections of streptomycin at 5-day intervals compared with infection controls. In the series in which the streptomycin was given only as a single injection of 25,000 units at 10-day intervals, the treated animals outlived the controls, so that the average of the controls was 20 days and that of the treated 70 days.

The foregoing experiments would appear to indicate that streptomycin does not act in tuberculosis as a simple chemotherapeutic retardant as it does in the test tube (since simple *in vitro* acting and *in vivo* distributed chemicals fail to affect tuberculosis), but that there is a threshold of remote sustained action. When initiated minimally, the effect persists for some time; above the maximum threshold effect, it is needless to continue forcing treatment, since the benefit derived does not exceed that of the established maximum. This information should extend the present use of streptomycin as an adjunct to the treatment of human tuberculosis and make streptomycin available for human treatment where excessive administration previously was economically prohibitive to certain cases.

It would appear that the amount and frequency of administration of streptomycin in tuberculosis can be reduced without appreciable loss of effectiveness. It is felt that the intimate mechanism of streptomycin action in tuberculosis still remains to be disclosed satisfactorily.

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A Possible Role of Food Purification in the Etiology of Dental Caries

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A study (*3*) has been made of factors influencing the caries susceptibility of rodents (36 mice, 53 Syrian hamsters, and 153 Long Evans strain rats). It has been possible to produce dental caries similar to that in man by feeding a finely powdered, purified ration (*1*) containing 67 per cent purified carbohydrates, primarily sucrose, and complete in known nutritional essentials. Caries did not develop in the mice and rats and was limited in the hamsters unless the experimental feeding on the purified diet was commenced during tooth development.

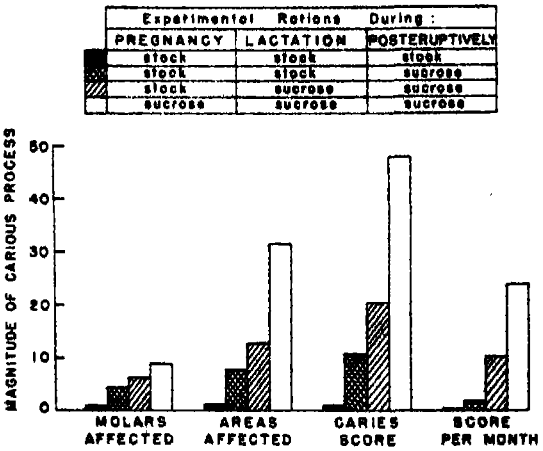

Fig. 1. The caries incidence of groups of hamsters whose experimental feeding on the purified ration was commenced *before*, *during*, and *after* tooth developments, respectively; their molars decayed in a ratio of 20:10:2. ("Sucrose" diet refers to the purified ration, containing 67 per cent sucrose. "Stock" diet refers to the Purina laboratory chow.)

The caries susceptibility appears to be greatly influenced by a mechanism (possibly an unrecognized nutritional factor) operating before tooth eruption from conception to maturation of the offspring and their individual teeth (see Fig. 1). In the light of these results a reinterpretation has been made of earlier observations in animals and man.

A review of previous failures to produce caries in various animals (*3*), including the primate, fed purified high sucrose diets suggests that the experimental feeding started out with too old animals, did not extend to second generations, or covered too short periods within one to overcome caries-resisting properties of the species, strain, or teeth in question.

An over-all analysis has been made of the trend of dental caries in about 800,000 children (*2*) surveyed by various workers in 11 European countries during the last 50 years. Following drastic reductions in consumption of refined carbohydrates at the beginning of the two World Wars, a marked caries reduction can be demonstrated. But the time relationship between the decrease in sugar consumption and the reduction in caries cannot be explained on the basis of a rapid mechanism in the oral environment. There is a delay of several years in the initial effect and a lag of many years in the terminal "effect of the wars" upon the caries reduction. This time factor can best be explained by an accumulative favorable effect before the teeth erupted into the oral environment (Fig. 2).

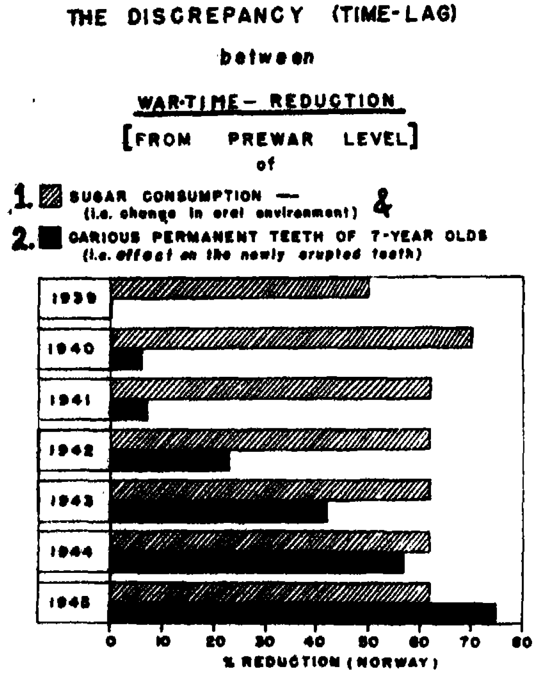

FIG. 2. A comparison of groups of 7-year-old children during each year of the war. Their permanent teeth *after eruption* were exposed to a similar sugar concentration in the oral environment. Significant caries reduction is seen in the teeth of those groups (1943/45) whose teeth had the longest "exposure" to the wartime diet *before eruption, i.e.* during development and final maturation.

The mechanism of this beneficial influence upon the teeth developing during the war is not known. It cannot be attributed to any obvious, over-all uniform increase in the consumption of any previously demonstrated caries-inhibiting food or food factor, but may be related to the fact that the bulk of the caloric intake during the wars was in the form of natural foods. The large caloric loss resulting from the sugar and fat rationing primarily seems to have been compensated for by an increased consumption of nonpurified carbohydrates, potatoes, cabbage, and wartime bread (containing 80–95 per cent of the grain).

In view of these experimental and clinical observations, it is possible that the long-suspected relationship between dental caries and the excessive consumption of refined carbohydrates may be in the nature of an unrecognized indirect influence upon the quality of the offspring and its developing teeth, and that the effect may be accumulated through generations.

The hypothesis of an accumulative depletion of a nutritional factor or combination of factors favorable to the developing teeth is being tested.

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Effect of Tetraethylammonium Chloride in Experimental Gastric Ulceration in the Rat

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Recently a method has been described for the uniform production of gastric ulceration in the rat (*4*). This method, or a modification of it, has been used to test the effectiveness of antiulcer factors (*5*). Harkins has reported (*2*) the complete prevention of gastric ulceration in rats by transabdominal vagotomy, using this method.

It has been shown (*1*) that the tetraethylammonium ion blocks the transmission of impulses at autonomic ganglia. In view of the reported effectiveness of vagotomy in preventing gastric ulceration in the rat and the widespread use of vagotomy in the clinical treatment of peptic ulcers, it was thought that the tetraethylammonium ion might prove useful in the therapy of this condition. Therefore, the effectiveness of this compound in preventing gastric ulceration in the rat has been studied.

Eighteen female rats weighing 80–100 grams were fasted for 72 hours. The rats were kept separated in cages with a wide wire-mesh bottom and were given water throughout the fasting and experimental period. They were anesthetized with ether. A short midline incision extending downward from the xiphoid process was made and the pylorus carefully exposed and ligated. The incision was closed with sutures, and the wound was covered with a thin coating of flexible collodion.

Alternate rats were injected intramuscularly with 1 mg. of tetraethylammonium chloride (Etamon chloride,[2] 1 ml. of saline solution) just prior to the pyloric ligation and at hourly intervals thereafter until death or until the animal was sacrificed.

The results are summarized in Table 1. Rat #1 died as a result of anesthetization, and rat #9, a control, has been omitted from the series because it was found dead 2.5 hours after pyloric ligation and showed no lesions at autopsy. It

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[1] The authors gratefully acknowledge the assistance of Woodrow Batten and J. I. Bumgarner in some of the experimental work.

[2] The Etamon chloride was generously supplied by E. C. Vonder Heide, of Parke, Davis & Company, Detroit, Michigan.

will be seen that all 7 of the controls died in less than 8 hours, with an average survival time of 6.7 hours. At autopsy, 6 of the 7 control rats showed perforation of the stomach. Of the 9 rats receiving Etamon chloride only 4 died; the shortest survival time was 7.1 hours, and only one of these 4 showed perforation. The remaining 5 experimental rats were sacrificed no sooner than 9.7 hours postoperatively, so that the shortest postpyloric ligation time was 1 hour longer than the longest control survival.

The stomachs were examined microscopically for ulceration. The results of this examination have been tabulated on the basis of an arbitrary division into two groups: (a) stomachs having ulcers in which one axis was at least 3 mm. long, and (b) stomachs having ulcers in which the longest axis was less than 3 mm. It will be seen that 6 of the 7 control rats were in the group having large ulcers in the rumen, while this was true of only 5 of 9 experimental rats. Furthermore, 3 of the 6 control rats had more than one large ulcer. Six of the 7 control rats were in the group having small ulcers in the rumen, and in 4 of these the ulcers were multiple. Four of the 9 experimental rats had small ulcers in the rumen, and in 3 of these the ulcers were multiple. One control rat each had a small ulcer in the body and in the antrum of the stomach. Three of the experimental rats showed no gastric ulceration, while all of the control rats showed ulceration.

TABLE 1

Rat No.	Weight (gram)	TEAC* (mg.)	Survival (hr.)	Perforation	No. of ulcers					
					3 mm. or greater			Less than 3 mm.		
					Rumen	Body	Antrum	Rumen	Body	Antrum
				Control series						
3	90	0	4.8	+	1	0	0	5	0	0
5	95	0	4.6	+	5	0	0	0	1	0
7	90	0	6.8	0	1	0	0	1	0	0
11	82	0	8.7	+	0	0	0	11	0	0
13	90	0	6.7	+	1	0	0	1	0	0
15	100	0	7.4	+	3	0	0	17	0	1
17	100	0	7.8	+	2	0	0	9	0	0
Total			46.8		13			44	1	1
Average			6.7		1.9			6.3		
				Experimental series						
2	95	13	12.8†	0	1	0	0	0	0	0
4	90	10	9.8	0	0	0	0	0	0	0
6	90	11	9.9	+	1	0	0	9	0	0
8	95	12	11.5†	0	0	0	0	8	0	0
10	90	11	11.2†	0	1	0	0	1	0	0
12	80	8	7.1	0	0	0	0	0	0	0
14	100	10	10.4†	0	0	0	0	0	0	0
16	88	8	7.8	0	1	0	0	0	0	0
18	95	10	9.7†	0	1	0	0	4	0	0
Total					5			22		
Average					0.6			2.4		

* Tetraethylammonium chloride.

† Rats were sacrificed after this survival time.

A comparison of the effect of Etamon chloride on gastric fluid volume and acidity was impossible due to the high incidence of perforation in the control series.

Although Etamon chloride did not completely prevent gastric ulceration in this series, on the basis of survival time, perforation, and incidence of ulceration it appears that it was definitely beneficial. When one considers the possibility that the difference between the two series might have been more striking had all remaining animals been sacrificed and examined after 7 hours (approximately the average survival time of the control rats), the probable clinical usefulness of Etamon chloride is enhanced.

Lyons, *et al.* (*3*) reported that in one hypertensive patient, who also had a duodenal ulcer, a single intramuscular injection of 1.2 gram of Etamon chloride resulted in the cessation of gastrointestinal motility, relief of the ulcer pain, and a decrease in the acidity and volume of the gastric juice. As the effects of the drug diminished, pain returned, at about 7 hours, and peristalsis was believed to be more rapid. We have studied the effect of Etamon chloride in two human patients who had active duodenal ulcers as well as in patients with other gastrointestinal disorders, with suggestive beneficial results. The clinical studies are being continued and will be reported elsewhere.

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A Method for Screening Antimalarial Compounds in the Mosquito Host

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Although methods of antimalarial drug screening have been improved and refined during the past several years, there has, nevertheless, been need for new screening technics, principally because it has not been possible to establish consistent or predictable relations between drug activity in experimental animal malarias and that in human malaria. For example, whereas sodium sulfadiazine and other sulfonamide derivatives have a kind of prophylactic effect against sporozoite-induced *Plasmodium gallinaceum* infections in chicks, these drugs are ineffective as prophylactic agents against human malarial infections. The present study was undertaken to devise a method of drug screening which would permit of more direct screening for certain drug qualities against a specific malarial parasite, or which would permit of screening of compounds for prophylactic effect against the human malarial parasite without the need for infecting undue numbers of human hosts.

In these experiments, laboratory strains of *Aëdes aegypti* were infected with a strain of *P. gallinaceum* designated as the 8A strain. Quinine hydrochloride, quinacrine hydrochloride, plasmochin citrate, 7-chloro-4-(4-diethyl-amino-1-methyl butyl amino)-3-methyl quinoline bisulfate (SN6911), and sodium sulfadiazine were prepared in solutions calculated in terms of the salt. These drugs were added in various concentrations to a 4 per cent sugar nutrient solution used as the standard maintenance diet for infected mosquitoes in this laboratory. Mosquitoes fed readily on these drug mixtures, and, as in animal drug testing, mortality or survival was directly related to drug levels. It is evident that mosquitoes on these diets took up the drug, since they survive for as long as 20 days following their infective meals, whereas mosquitoes will not survive beyond 48 hours when deprived of food and water. Generally, in infected mosquitoes maintained on sugar solutions there is an average mortality of 30–35 per cent during the period of the experiment, and in these studies the maximum tolerated dose was considered to be that dosage in which mortality was approximately 60–70 per cent, or double that of the normal attrition. Usually, drug administration was begun 72 hours before the mosquitoes were given their infective blood meals and continued throughout the course of the infection. Later, drug schedules were varied according to the needs of an experiment.

TABLE 1

COMPARISON OF THE EFFECTS OF VARIOUS DRUGS ON THE SPOROGONOUS CYCLE OF *P. gallinaceum* IN *A. aegypti* AS DETERMINED BY SUBSEQUENT INOCULATION INTO CHICKS*

Drug	Drug conc. (grams/ 100 ml.)	Average per cent red cells parasitized (days after inoculation)						No. survivors
		8	10	12	14	16	18	
Quinine	.08	4.2	29.1	28.0				0/8
Quinacrine	.03	3.7	26.8	32.0	22.0			1/8
Plasmochin	.02	3.1	25.9	36.2				0/8
SN6911	.075	4.0	32.1	58	39.1			0/9
Sodium sulfadiazine	.1	0	0	0	0	0	0	8/8
Controls		2.8	31.7	30.9				1/8

* Inoculum contained one mosquito equivalent.

With this drug-diet method it has been possible to administer drugs to mosquitoes infected with *P. gallinaceum* and to test the effects of these compounds on the sporogonous cycle of the parasite. It has been found that quinine, quinacrine, plasmochin, and SN6911 administered in maximum tolerated doses have no effect on sporozoite production or sporozoite viability, and sporozoites from mosquitoes treated with these drugs, inoculated into normal chicks, produce infections indistinguishable from those produced by the inoculation of sporozoites from control mosquitoes maintained on sugar solutions alone. On the other hand, in infected mosquitoes treated with adequate concentrations of sodium sulfadiazine, oocysts fail to develop properly and sporozoites are produced only rarely, and those that are produced appear to be incapable of inducing infection when inoculated into normal chicks (Table 1).

Suspensions of mosquitoes prepared from those maintained on sugar solutions and on quinine, quinacrine, plasmochin, and SN6911 ordinarily contain two to three sporozoites per oil immersion field, whereas it may require 10 minutes examination to find a single sporozoite in suspensions prepared from mosquitoes maintained on 0.1 per cent sodium sulfadiazine. With higher concentrations of sodium sulfadiazine it becomes even more difficult to find sporozoites. Thus, drug effect can be readily discerned from microscopic examination of suspensions prepared from drug-treated mosquitoes, and one can predict with accuracy the outcome of subsequent inoculations from suspensions prepared from drug-treated or control mosquitoes.

During the course of several experiments, inoculation of whole mosquitoes or of several mosquito equivalents of those maintained on sulfadiazine levels above 0.1 per cent has failed to produce infection. Reinoculation of these negative chicks has resulted in characteristic infections with high parasitemias. At a 0.1 per cent level oocysts are formed in large numbers but rarely grow beyond the medial point of development. With concentration of sulfadiazine increased to 0.3 per cent, there is more complete inhibition of oocyst development, and at maximum tolerated levels oocyst development appears to be more completely arrested. However, below 0.1 per cent, which appears to be the critical concentration of the drug, sporozoite production and viability are not too seriously affected, and sporozoites from mosquitoes treated with lower concentrations produce characteristic infections when inoculated into normal birds (Table 2).

TABLE 2

COMPARISON OF THE RELATION OF DRUG CONCENTRATION TO DRUG ACTIVITY IN *A. aegypti* INFECTED WITH *P. gallinaceum* AS DETERMINED BY SUBSEQUENT INOCULATION INTO CHICKS

Drug	Drug conc. (grams/ 100 ml.)	Average per cent red cells parasitized (days after inoculation)				No. survivors
		8	10	12	14	
Sodium sulfadiazine	.01	1.0	30.0	8.0		2/6
"	.05	0	1.0	8.2	23.0	2/6*
"	.1	0	0	0	0	6/6
"	.3	0	0	0	0	6/6
"	.4	0	0	0	0	6/6

* One chick remained negative.

From the known drug effects of sulfadiazine and the other drugs cited on sporozoite-induced infections of *P. gallinaceum* it would appear, therefore, that there is a definite relation between drug activity and effect in the sporozoite-infected vertebrate host and drug activity in the infected invertebrate host. The analogy extends further, in that sulfadiazine has little or no effect if drug administration is delayed until sporozoites have developed. High concentrations of drug administered over a period of several days after sporozoites have developed do not affect sporozoite viability, and sporozoites from mosquitoes so treated give rise to typical infections when inoculated into normal chicks. Furthermore, if drug administration is terminated too quickly following the infective meal, infective sporozoites are produced even though development is delayed.

With this method it may become possible to evaluate drugs directly in the mosquito host for their prophylactic activity against the human malarial parasite and thus to eliminate the necessity, according to present-day screening methods, of infecting large numbers of human subjects. The method may possibly offer further promise as another means for studies on parasite metabolism and for studies on the mechanisms of drug action.

IN THE LABORATORY

Oxidation of Ascorbic Acid to Dehydroascorbic Acid

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In the Roe and Oesterling method (*2*) for the determination of ascorbic acid in plant tissue, norite is used for the oxidation of ascorbic acid to dehydroascorbic acid. The most commonly used extractant is a metaphosphoric acid solution in which norite does not oxidize ascorbic acid quantitatively to dehydroascorbic acid unless acetic or trichloroacetic acids are present in a relatively high concentration. Bromine, which has been proposed for the oxidation of ascorbic acid to dehydroascorbic acid in a metaphosphoric acid solution (*1*), is not a desirable reagent to use for this purpose because of its physical and toxic properties.

In this laboratory 2,6-dichlorobenzenoneindophenol has been used in the place of norite or bromine. The ascorbic acid is quantitatively oxidized to dehydroascorbic acid in a metaphosphoric acid solution. The color, due to the excess dye present in the sample, is destroyed when the thiourea solution is added. Not only does use of the dye permit a more rapid determination, but both the ascorbic and dehydroascorbic acids can be determined on the same acid tissue extract with a single standard curve.

Sodium 2,6-dichlorobenzenoneindophenol dye solution: Dissolve 200 mg. of the dye in 100 ml. of warm water, filter, and store in a refrigerator. Prepare freshly every two weeks.

Metaphosphoric-thiourea solution: Prepare a 20 per cent metaphosphoric acid solution in cold distilled water. Filter if necessary and store in a refrigerator. If the acid extractant used is 1, 2, 3, 4, or 5 per cent metaphosphoric acid, transfer 45, 40, 35, 30, 25 ml., respectively, of the 20 per cent metaphosphoric acid solution to a 100-ml. volumetric flask. Then add 2 grams of thiourea and distilled water. Dissolve by shaking and make up to volume. Thus, 2 ml. of the acid-thiourea solution added to 2 ml. of the extractant gives a solution containing 5 per cent metaphosphoric acid and 1 per cent thiourea.

Transfer 2 ml. of the acid tissue extract to each of three colorimetric tubes. Add one drop of the dye solution to one of these tubes. Shake tube. Some color should persist; if not, the ascorbic acid is too concentrated for obtaining best results, and the tissue extract should be diluted further with the acid extractant. Then add 2 ml. of metaphosphoric-thiourea solution to all three tubes. Reserve one tube for the blank, but to each of the other two tubes, including that to which the dye has been added, add 1 ml. of the 2,4-dinitrophenylhydrazine reagent and continue the procedure as described by Roe in his method for the determination of ascorbic acid.

A standard curve is made with known quantities of ascorbic acid in a metaphosphoric acid solution under exactly the same conditions as described for the unknown. It is important to have the same final acid concentration (5 per cent metaphosphoric acid) for all determinations if results are to be compared with a single standard curve.

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A Simple Pen for Kymograph Tracings

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In many cases a smoked kymograph drum is a decided inconvenience, and a record in ink is advantageous.

A satisfactory pen can easily be made by drawing a piece of 4-mm. glass tubing to an L-shaped capillary point and cementing[1] this into a folded piece of 16-mm. film negative. Slits made in the film enable the pen to be adjusted to any length on the lever arm. The capillary tip can be finished on very fine emery polishing paper so that it will give a smooth tracing. The pen can be refilled with a capillary tip medicine dropper while it is writing and will hold enough ink for several hours of continous tracings. When not in use, the pen is removed from the lever arm and placed in a beaker of water to prevent the ink from drying in the tip. Any fountain pen ink has been found satisfactory.

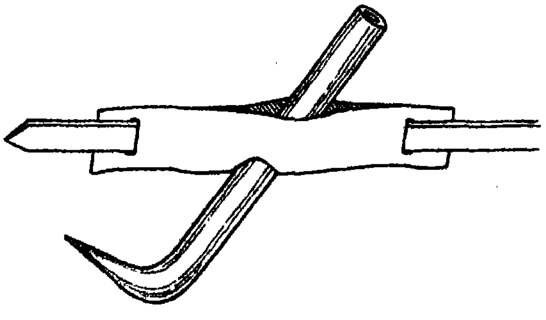

Fig. 1

The pen is not heavy enough to affect the sensitivity of respiration or activity as transmitted by a tambour and has been successfully used on signal magnets as well as in recording pressure changes in a closed system.

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[1] Dupont Duco cement mixed with acetone was found most satisfactory for this.

A Simple Method for Explanting and Cultivating Early Chick Embryos *in Vitro*

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The *in vitro* technique, in spite of its usefulness in the study of many problems of embryonic development, has generally been considered far too difficult and complicated to be used in classroom experiments. This is probably true of the classical tissue culture technique with all of its special equipment and elaborate sterilization and blood-taking procedures. The following method, which has been designed for student use, dispenses with all of these but is just as effective and reliable in terms of the results it gives (Fig. 1). In the brief but complete procedure outlined below, no sterilization of equipment or solutions is necessary because of the bacteriolytic property of egg albumen used in the culture medium. Tap water may be used in place of distilled water. (When synthetic media, yolk-extract media, etc. containing no egg albumen are used, all glassware and instruments are dry sterilized and solutions are autoclaved.)

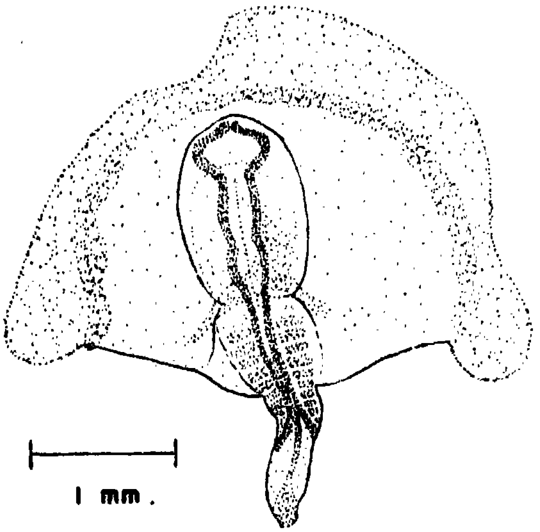

FIG. 1. Camera lucida drawing of a typical 10-hour-old, living explant of the anterior portion of a short head-process blastoderm which was transected about 0.4 mm. posterior to the node. This result was obtained after carrying out verbatim the method outlined for saline-agar-albumen media. With a little practice, the student can accumulate many similar cases of beautifully symmetrical and essentially normal morphogenesis.

Equipment. The following ordinary laboratory equipment is all that is necessary: 1 dozen Petri dishes (4 inches in diameter), 1 dozen watch crystals (2 inches in diameter), absorbent cotton (ca. 40 grams), 1 finger bowl (4½ inches in diameter), 2 Erlenmeyer flasks (ca. 500 cc.), 1 Erlenmeyer flask (ca. 125 cc.), 1 graduated cylinder (100 cc.), 1 wide-mouthed pipette (inside diameter, 3–4 mm.), 1 fine pipette (inside mouth diameter, ca. 1 mm.), 1 student dissecting set (2 needles, 1 pair of scissors, 1 pair of forceps), and 1 dissecting microscope.

Preparation of equipment. The glassware and dissecting instruments are thoroughly washed, rinsed in hot, running, tap water, and set aside to dry on a clean towel. The culture dishes (which have a large, humid, air space) are like those used by Fell and Robison (*1*). These are assembled by placing a moist cotton ring in each Petri dish, placing a watch crystal (concave side up) on this, and replacing the cover of the dish.

Preparation of culture medium. The final medium consists of two components which are made up separately and combined just before the medium is placed in the culture dishes. *Part I* (Ringer-albumen): The egg white from one unincubated egg (after separation from the yolk in the usual fashion) is added to 50 cc. of ordinary chick Ringer solution (0.9 per cent NaCl, 0.042 per cent KCl, 0.024 per cent $CaCl_2$) contained in a 500-cc flask. The flask is stoppered and shaken vigorously for about 1 minute. *Part II* (Ringer-agar): 0.13–0.15 gram of agar (U.S.P. XI) is placed in the small flask along with 30 cc. of Ringer solution. The Ringer-agar is carefully brought to a boil over a Bunsen burner. A small flame is used, and the flask is frequently agitated to prevent the agar from sticking.

When the Ringer-agar has cooled down to about 40°–45° C., 20 cc. of the Ringer-albumen component (exclusive of the foamy portion) is added, and the flask is gently shaken to mix the two. Approximately 2 cc. of the medium is poured out into each watch crystal. The medium is allowed to gel (ca. 30 minutes–1 hour) before the Petri dishes are moved.

Operative procedure. Eggs containing the embryos to be cultivated[1] are opened into a finger bowl containing about 100 cc. of Ringer solution. The yolk is held steady with the forceps while a cut (ca. ¼ inch from the border of the blastoderm) is made through the vitelline membrane with the scissors and carried all the way around the blastoderm. The vitelline membrane with the blastoderm adhering to its underside is grasped at the cut edge and gently rolled back from the yolk. The blastoderm is then freed from the membrane by gently working a dissecting needle around its border (a fairly blunt needle is best and can be used to push or roll the blastoderm away from the membrane). It is then transferred in the wide-mouthed pipette to a Petri dish containing about 20 cc. of Ringer solution. Under a dissecting microscope, most or all of the yolky opaque area is trimmed off with the dissecting needles. When finer operations are performed on the embryo, it is important to use freshly sharpened needles.

Culture procedure. The embryo or parts of it to be cultivated are transferred in a wide-mouthed pipette to the surface of the culture medium, oriented as desired, and flattened out by gently sucking away the excess saline with a fine pipette. The blastoderm may be marked with carbon powder if desired (*2*). The Petri dish is covered and placed in the incubator.

With minor modifications,[2] the basic procedure outlined above is being used in the study of some of the problems of early embryonic nutrition, morphogenesis, localization of organ-forming areas, etc. The results of some of these studies will be reported in the near future.

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[1] Incubation at ca. 38° C. for 20–25 hours will furnish definitive primitive streak, head-process, head-fold, and early somite blastoderms. A simple incubator made out of a desk lamp and a cardboard carton can be used for the eggs as well as the cultures.

[2] For example, when glucose (100–800 mg. per cent, added to the Ringer-agar solution) is substituted for the albumen, some interesting effects on development can be observed.

An Interesting Case of Water Undercooling

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"If a pure liquid is carefully protected from mechanical disturbances, it may be cooled below the temperature at which it normally solidifies. Thus, water may be cooled to −10° C. or lower without becoming ice. The liquid at such a temperature is in a state of unstable equilibrium and will immediately solidify if disturbed or if a crystal of the solid is dropped into it" (*1*). Some such statement appears in physics texts when the subject of undercooling of a liquid is discussed. The difficulties of obtaining a successful mass demonstration of the undercooling of water are well known.

In investigations of the operating characteristics of home freezers in this Bureau, the tests include the freezing of a volume-capacity load with water as the test material in pint, paraffined, nested, cardboard containers with disc lids. Copper-constantan thermocouples are used with recording potentiometers. Since each instrument records its series of 16 points in approximately one minute, the temperature at each location can be followed quite closely.

Temperatures are taken in enough cartons, distributed throughout the freezing load, to be sure that they are obtained in the first and last cartons to freeze. In the case reported here, temperatures were taken in 7 of the 67 cartons comprising the full load. Undercooling occurred in 5 of these 7 cartons. If the phenomenon took place in the same proportion for all of the cartons, 48 of them undercooled.

The requirements generally stressed in textbooks for the phenomenon of undercooling are purity of liquid, absence of foreign substances, and absence of mechanical disturbance. Under the conditions in which the freezing tests are conducted in our laboratories, undercooling of water might be expected to be a rare occurrence. Actually, however, it is the rare occurrence when one or more of the cartons in which thermocouples are placed in a freezing load do not show undercooling.

In this particular part of the experimental work, there is no necessity for having the materials scrupulously clean. The thermocouples are either new, no attempt having been made to remove the soldering flux completely, or have been kept loose in a drawer since their previous use. More often than not, the cartons have been reparaffined one or more times if, in previous use, freezing cracked the seams. The water used is the ordinary distilled water of the laboratory, placed in the cartons the day before and allowed to stand uncovered at least 17 hours before the start of the test.

The test is begun at the start of an "on" period of a cycle. Hence, the cartons are subjected to continuous vibration if the compressor stays in operation until the end of the "freezing period," *i.e.* until the temperature in the last carton reaches 10° F. If the compressor cycles during that time, the cartons are subjected to the sudden jarrings at the start of the "on" periods and vibration during the running parts of the cycles.

The freezing compartment of the freezer being tested in the case discussed here was directly above the compressor, thus receiving the full impact of the starting of each period of operation. To check the magnitude of the agitation during the cycling of the compressor unit, at the conclusion of the test some uncovered cartons were distributed throughout a load in the freezing compartment. Standing waves of quite large amplitude were observed in each such carton, indicating that rather forceful disturbance was present while the compressor was in operation. During the test the compressor unit ran continuously for about 3 hours after the load was placed and then cycled approximately 260 times during the remaining 93 hours of the test. Some one or more of the cartons was in an undercooled state during 60 of these hours, during which time the compressor cycled 160 times. These figures do not support part of the quotation, viz., "The liquid at such a temperature is in a state of unstable equilibrium and will immediately solidify if disturbed. . . ."

Fig. 1 gives the temperature-time relationships in 6 of the 7 cartons in which temperatures were taken. Curve F is typical of those for a liquid passing through its solidification temperature without undercooling. Curves A and B are typical of the usual temperature-time relationships observed when undercooling does occur. Curves C, D, and E are seemingly atypical, but show the relationships when undercooling is prolonged.

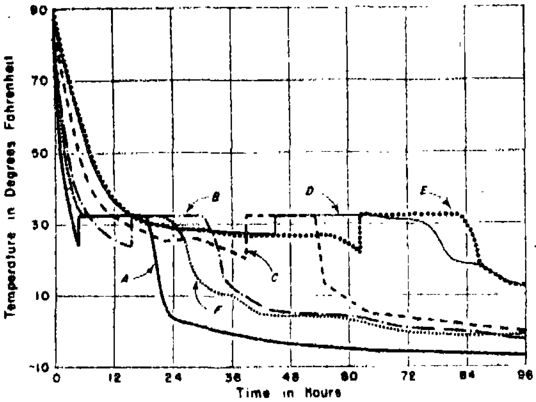

FIG. 1. Undercooling of water during home-freezer test.

Rapidity of cooling to and through 32° F. was not the deciding factor as to whether or not undercooling occurred. Curve A passes rapidly through the solidification temperature of 32° F., Curve E very slowly, and yet each exhibits undercooling. Curve F, representing a carton in which undercooling did not take place, came to the solidification temperature at a speed intermediate to these two. The temperature in the 7th carton (curve not shown) dropped to 32° F. more rapidly than any of the 6 for which curves are shown, and the water did not undercool.

An interesting feature shown by the graph is that, during the 9-hour period from 30 to 39 hours, the water in none of the cartons was at 32° F.; in three cartons the water had completely solidified, and in the other three it was in an undercooled state. Apparently the phenomenon of undercooling of water which is thought of as occurring only under nearly ideal conditions actually takes place under conditions far from ideal and does so to such an extent as to make questionable the accepted restrictions on the conditions required for its occurrence.

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Book Reviews

Fundamentals of earth science. Henry Dewey Thompson. New York-London: D. Appleton-Century, 1947. Pp. xiii + 461. (Illustrated.) $3.75.

In the preface it is stated that the book is written with a twofold purpose. The first objective, according to the author is "to present a well-balanced, one semester survey of earth science which will give the college student who takes only one course a rather complete elementary picture of the earth." The second objective is "to provide a basic text for beginning students in either geology or geography." Dr. Thompson has achieved both purposes admirably.

The student who does not go on for additional work in these fields will benefit culturally by acquiring an intelligent appreciation of scenery and a knowledge of the physical environment in which he lives. The student who desires to dig deeper into geology and geography has a good foundation upon which to build.

The author of any survey text is faced with the problem of how much material he can include and still keep the volume to a size that can be covered in one semester of study. The material covered is extensive, carefully selected, and includes all branches of earth science. About 25 pages are devoted to historical geology. Generally, the material is presented with thoroughness. In the opinion of the reviewer, however, the role of chemical weathering in semiarid and arid regions does not receive enough emphasis, and the part played by chemical weathering in *exfoliation* should be mentioned. For teaching purposes it would be of greater service if the cloud families were included.

Although the reproduction of several of the illustrations is not very clear, the book is amply illustrated and the author is to be commended for his explanation and use of aerial photographs. The choice of words, the clarity, and the ease with which the book can be read are outstanding features.

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Quantitative clinical chemistry: interpretations. (Vol. I.) (2nd ed.) John P. Peters and Donald D. Van Slyke. Baltimore: Williams & Wilkins, 1946. Pp. vii + 1041. (Illustrated.) $7.00.

The first edition of this text by these two outstanding authorities in the fields of clinical chemistry and clinical medicine quickly gained recognition as the authoritative work in this field. The chemical and physiological facts and their interpretation in disease were presented on the basis of an exhaustive review of the literature, with citation of references. In the 15 years which have elapsed since the first edition so many advances have been made that the authors felt it necessary to rewrite, not re-edit, the first edition.

In Volume I of this second edition the material presented in the first half of the original volume on interpretations has been reclassified and expanded to about double the original size. The new Volume I consists of four parts, Energy Metabolism Carbohydrates, Lipids, and Protein Metabolism, presented in 13 chapters. Two of the chapters under lipids are new, viz., steroid hormones and fat-soluble vitamins.

The authors have done an excellent job of reviewing the enormous literature (4,600 references) and presenting the pertinent facts in logical order. Furthermore, the style is such that the experimental data covering the important observations are connected to make easy and stimulating reading. The material has been presented critically on the basis of the authors' intimate and expert knowledge of the field. If the reader should disagree with interpretations or desire fuller information, the unusually complete bibliography will enable him to consult the original papers. The text is unusually free from typographical and other errors. It should be available to all students and teachers of biochemistry and is an essential reference book for clinical chemists and up-to-date internists and pediatricians.

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Essentials of endocrinology. (2nd ed.) Arthur Grollman. Philadelphia: J. B. Lippincott, 1947. Pp. xxiii + 644. (Illustrated.) $10.00.

The decline of interest in endocrine research caused by the late war would seem to create a propitious moment for the crystallization of available information in the form of a book such as that being reviewed. However, the wide ramifications of endocrinology and the many fields of basic science which it involves make the writing of such a book by a single individual a tremendous task indeed.

In this attempt, the anatomy, physiology, pharmacology, and pathology of the ductless glands are discussed as well as endocrine diseases and their treatment. The application of the findings of basic endocrine research to clinical medicine is viewed with a refreshing conservatism. Portions dealing with clinical problems and pathology are well illustrated. Less can be said for some of the illustrative material dealing with the anatomy of the glands. Inaccurate or illogical statements, although occasionally found, seem to be remarkably few in number. Generalizations drawn from scattered research findings in such an immature field are certain to find ready opposition. This is true of many of the author's statements. If intended for use as a text, reorganization of some of the material to give greater conciseness of presentation would be desirable.

This book is the best of its kind available. Whatever major criticism might be raised against it would arise largely from the problems faced by any one individual who seeks to master all phases of endocrinology so that he may acquire sufficient background to authoritatively select and present information with the proper perspective.

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Biology of Cancer

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I BELIEVE THAT CANCER IS THE MOST challenging disease which confronts biological science. It involves the most basic phenomenon in biology, namely, growth. It is characterized by an abnormal, unlimited, unregulated growth of tissue which destroys the host which nourishes it. It is unique among diseases because the host is consumed by its own flesh. The thought of this fact, the frequently associated pain, and the insidiousness and treachery of its attack place cancer first among the most dreaded diseases.

The basic principles of cancer as a descriptive science were known to Galen (150 A.D.), who recognized three classes of tumors. The tumors of his third class were referred to as "tumors contrary to nature." They were called "contrary to nature" because of their abnormal and unregulated growth and frequently destructive character. There were two types, one benign and the other malignant; the latter was called "cancer."

About the middle of the 19th Century, when it became generally agreed that a cancer consisted of cells, two hypotheses regarding the nature of cancer received recognition. One maintained that normal cells can be transformed into cancer cells by irritation or infection of some type; the other, that the cells which form cancer were cancerous from embryonal life as the result of an hereditary blemish or an embryonal rest of cells excluded from the line of normal development.

These are the principal ideas contributed by the descriptive scientific approach to the problem of the cause of cancer. In addition much important and very valuable information which led to the morphologic classification and diagnosis of the disease was accumulated.

The descriptive science of cancer added nothing to the treatment of the disease, since therapeutics is entirely an experimental science. And, it is generally agreed that the cause of a disease remains a theory until established by controlled experimentation.

The study of cancer as an experimental science began just prior to the turn of the century, when cancer was first transplanted in laboratory animals by Hanau (1889) and Moreau (1891)—a fact which was soon confirmed by Leo Loeb (1901) and Jensen (1902). Since then, spontaneous cancer has been observed in almost all species of animals; cancer susceptibility has been bred into and out of animals; cancer has been produced by various types of chemical substances (carcinogens); and the chemotherapeutic action of hundreds of chemical compounds have been assayed on animals with transplanted tumors. This approach has contributed a mass of basic information to the problem of cancer. Moreover, all the knowledge, tools, and techniques of biology and medicine and of chemistry and physics have been focused on the problem. No known aspect has escaped some experimental attention. Many facts have been established, and a few optimistic experienced students of the problem believe that so much has been discovered in the last 20 years that the therapeutic control of advanced cancer is "just around the corner."

One of the most significant contributions of the last 25 years has been *the unequivocal proof* that cancer can be cured by removal or destruction if recognized early enough. But the grim and urgent problem is to prevent, cure, or control advanced cancer.

The most productive research for the treatment of advanced cancer, from the viewpoint of present applications, has been the development of the hormonal relationships to cancer of the prostate (*10*) and breast (*9*). This success clearly demonstrates that the most significant work to be done in the forseeable future is basic research, both experimental and descriptive. The currently sick must be cared for, of course; but we must look also toward the future saving of millions of lives.

The advances in the basic knowledge of cancer have not yet answered with certainty some of the fundamental biological questions.

What is the difference between a benign and a malignant tumor?

At present it is not possible to draw a clear line of distinction between a benign and a malignant tumor except to say that, when a benign tumor starts to invade and metastasize, it has undergone malignant transformation. That such may occur has been demonstrated experimentally, e.g. the Shope papilloma (*24*), and the papilloma induced with tar (*11*), and the clinical evidence is strongly presumptive (*27*).

Invasiveness and metastasis do not always signify that a tumor is a cancer or truly destructive of the host. For example, the chorionic villi (fetal part of the placenta) invade the endometrium (uterus) up to a stage of placental development and then act like a benign growth, even though the placental tissue has a carbohydrate metabolic pattern like malignant tissue (*7*). Also, during pregnancy chorionic cells enter the blood stream and lodge in the lungs, but they do not form tumors there. The chorioadenoma extensively invades the wall of the uterus and surrounding structures and may even metastasize to

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This address was presented at the Fourth International Cancer Research Congress, St. Louis, Missouri, September 3, 1947.

the lungs, but tumors are not formed or, if so, they regress. The choriocarcinoma, however, invades, metastasizes, and destroys the host (*5*).

Some believe that a benign colloid goiter (tumor of the thyroid gland) may metastasize to the lungs of man and dogs (*5*). According to my own experience obtained between 1918 and 1925, when all the adult dogs in Chicago were goiterous, I found evidence of local invasiveness in some 10 dogs in which thyroid metastases were formed in the lungs. I was unable, however, to produce lung tumors by introducing small pieces or a "cell" suspension of a thyroid which appeared to be "carcinomatous" into the external jugular vein. This may have been due to the heterologous nature of the tissue used or to other factors. Dr. Huggins, of the University of Chicago, has informed me that he has been unsuccessful when he similarly used hyperplastic prostatic tissue in the dog.

Between 1918 and 1925 I autopsied approximately 2,000 adult dogs in Chicago among which the incidence of goiter was 98 per cent and of "cancer" of the thyroid with gross pulmonary metastases, 1.6 per cent. Goiters and cancer of the thyroid completely disappeared from Chicago dogs after 1925, or one or two years after iodized salt became a general grocery store commodity.

It is difficult, for these and other reasons, to avoid the view that, fundamentally, benign and malignant tumors are manifestations of the same neoplastic principle, the benign tumor or cell representing an arrested or inhibited stage of a potentially malignant process.

Does the cancer cell represent a transformation of a normal cell or a cell abnormal from embryonic life?

All the evidence with which I am familiar may be interpreted as indicating that the cells transformed into malignant cells may arise either from embryonal residues or from normal cells which are more susceptible than other normal cells in the same organ. Even the apparent transformation of fibroblasts into sarcoma cells in tissue culture by treatment with methylcholanthrene, as observed by Earle (*21*), is not sufficiently free from a possible experimental error to invalidate the theory of embryonal residues being involved.

But it is really immaterial, except from a taxonomical point of view, whether a normal cell or an "embryonical residue" is changed. This is true because the growth of fetal tissues and the placenta throughout their normal course is regulated, regardless of the fact that they have a metabolic pattern like malignant tissue. The important biological question is:

What is the nature of the process induced either into the normal cells or, if one prefers, the "embryonal residue" when they become cancerous or truly malignant?

The nature of "the autonomous" or "the malignant process" still appears to be the most fundamental question pertaining to the biology of cancer. It would appear that the rational approach to the secret of the cure of cancer is to ascertain either the factors which are responsible for causing unregulated, unlimited, invasive, metastatic, and destructive growth or those which are responsible for limiting and regulating normal growth.

The autonomous nature of cancer. A tumor is sometimes defined as "an autonomous new growth of tissue" (Ewing). Autonomous implies growth unregulated and independent of the host except for nourishment. Malignant implies destructiveness due to invasiveness and metastasis.

If a malignant growth is entirely autonomous except for nourishment, nothing manufactured in the body of the host except food of some type could influence it. This is not true of some cases of cancer of the prostate with metastasis to the bone in man, since Huggins and his colleagues and others (*10*) have observed the disappearance of metastases in bone and the primary tumor after castration or the administration of large doses of stilbesterol to the patient. The cells of tumors of the prostate and breast which are markedly benefited by modifying the sex hormone supply may not be sufficiently transformed to be entirely autonomous. Of course, it may be that in the case of the prostate, one is dealing with a very special case, since its embryonal development is specifically stimulated or inhibited by male and female sex hormones, respectively. In this connection it would be of interest to know what effect testosterone might have on chorioadenoma (v.s.) and choriocarcinoma (v.s.). It would also be significant to know the effect of the growth-promoting activities of the thyroid gland (*19*) and the anterior lobe of the pituitary gland on the growth of cancer. Would the so-called "anti-hormone" of the thyrotropic hormone produced by the hypophysis affect a carcinomatous thyroid?

The autonomous nature of a malignant tumor should not be viewed too rigidly. A rigid adherence to this hypothesis is probably contrary to the facts, and its pessimistic implications tend to retard discovery of knowledge regarding the nature and cure of cancer. In fact, when one considers all the factors inside and outside the cell which affect growth and the great care which must be exercised in the tissue culture of malignant cells, it is difficult to accept the view that any tumor is completely autonomous relative to its rate of growth, even though it may be completely autonomous in regard to its invasive and metastatic properties.

The uniformity of the chemistry of malignant tissue. The strongest evidence that the malignant process is identical, in what may be termed fully transformed malignant tissue, has been obtained primarily from naturally occurring and artifically induced transplantable tumors. It shows that a marked similarity exists in the chemical properties (composition, enzyme, and metabolic pattern) of a malignant tissue regardless of the species or the histogenetic source of the tumor tissue (*7*). Malignant tissues as a class appear to be as unique chemically as liver tissue or gastric mucosa. I have been particularly awed by the chemical and metabolic similarity of the tissue of a hepatoma (metastasizing tumor of a rat's liver) and a gastric adenocarcinoma (cancer produced artificially in a rat's stomach), two tissues which in normal life appear to have very little in common. I have also been impressed by the fact that very rapidly regenerating hepatic tissue has a normal metabolic pattern, whereas hepatoma tissue has the metabolic pattern of malignant and fetal tissue (7). The chemical results, of course, support the old theory that malignant tissue represents a reversion to an embryonic type of cell, the growth and reproduction of which is exquisitely regulated and limited. This apparent uniformity of the chemical pattern of malignant tissue may represent an oversimplification, as has been suggested by biochemists working in this field. Regardless of their remarkable contributions, these biochemists recognize that their chemical techniques are still relatively crude and that our knowledge of the chemistry of the normal as well as the cancer cell is in a pioneer state.

If the chemistry of malignant tissues or the malignant process is identical for all malignant tumors and if it is significantly different from normal tissue, one therapy should be applicable to all malignant tumors. The alternate assumption is that the various cancers represent separate malignant processes, or different stages of the malignant process, and a therapy for each will have to be discovered. Morphologically the organ of origin of a malignancy is recognizable in approximately 90 per cent of the cases seen clinically in man. This would suggest that there may exist some competition or overlap between the chemical pattern of the original normal cell and the malignant cell. With present methods this possibility cannot be analyzed with certainty because such a tumor may contain a variable number of premalignant and malignant cells. The answer to this question probably awaits the development of histochemical methods which would reveal the difference between the chemistry of a normal adult cell, an irritated adult cell, a precancerous cell, and a malignant cell. There is no evidence which would show that a cell today has the metabolic pattern of a normal cell and, at the next division, that of a malignant cell. There are geneticists (*25*) who believe that such a somatic mutation may occur and point out that it may explain the alleged "irrevocable character of the malignant change." If such does occur, the fundamental chemical nature of the malignant process could still be the same and respond to a uniform therapy.

Although the malignant process may be essentially the same in all malignant tissues, it may be conditioned or controlled by several factors which vary with the etiology and the tissue from which the tumor arises. If the therapeutic evidence we now have has any bearing on the nature of the malignant process and the factors which condition it, each type of tumor may demand a separate therapy. For example, hormones are used successfully in the treatment of cancer of the prostate and breast; the X-ray sensitivity of various tumors varies widely; and, a definite difference exists in the ease with which toxic substances cause hemorrhage in an experimentally induced sarcoma and carcinoma.

In my thinking of cancer, I frequently use analogously the animal parasites. The "heart worm," or the adult canine filaria, receives its nourishment from the host; it is autonomous with respect to its own growth and reproduction; it is a unique tissue and has a unique metabolism which, however, is probably different from that of other parasites as well as tumor tissue, because its cells are differentiated. Is our problem in cancer, as in the case of parasites, to find a substance which is toxic or essential for each type of cancer, or is it to find one which will be toxic or essential for all cancers? In view of our ignorance, we shall have to accept both as working hypotheses.

In view of the fact that the change in the chemistry and metabolic pattern of a normal or "irritated" tissue into that of malignant tissue is relatively abrupt and distinct in some known respects (7), I firmly believe that ways will be found for systemically destroying malignant cells without destroying the normal cells of the host. This is apparently what the X-rays or gamma rays do in the case of cancer of the skin (*6*). I remember being told as a student that gallstones could never be dissolved without dissolving the tissues of the host. Yet, thanks to skeptics who experiment, we now know that if gallstones are placed in the gall bladder of a dog, they are dissolved quite rapidly; so the problem of the solution of gallstones is to find a way to change the fatty acid-cholesterol ratio in human bile toward that found in dog's bile. Similarly, the chemical data obtained on cancer provide much hope and encouragement for the view that further studies will answer the crucial question of the nature of the malignant process, or at least show the way to the proper systemic therapeusis.

Multiplicity of causative factors in tumor genesis. One of the best examples of the multiplicity of factors concerned in the induction of tumors comes from the intriguing studies of the natural occurrence of mammary cancer in many inbred strains of mice. At least three factors are involved: (1) a genetic constitution, or pattern, or inherited susceptibility; (2) the female sex hormone; and (3) the "virus-like" agent transmitted in the milk of the mice (*3*). For example, estrogen must be given to male mice before they will develop the tumor, and spayed females will not develop the tumor unless given estrogen. Though the inciting agent is present in all of the tissues of the exposed mouse, it predisposes only to mammary tumors. In addition, the age at which the agent is introduced is a factor. Even with the best-known combination of these factors, some 9 months are required for the appearance of the tumor, or the latent period of induction is very long in the life of a mouse. And further, though rabbits and rats form a neutralizing antibody for the milk factor, the mouse does not, and an antimouse tissue serum has no effect on it. Finally, though other factors probably exist, the diet during the period of tumor development exerts an influence on the incidence of the mammary tumors in mice (*26*).

Many other examples exist showing the complexity of the endogenous and exogenous factors concerned in the genesis of cancer in mice. To render the problem still more complex, the species differences are marked, and the influence of factors which predispose to cancer in one species may retard in another species. For example, though reproduction and nursing unequivocally predispose to cancer of the breast in the strains of female mice studied, it has the opposite effect on women.

Paucity of information on the dietary control of cancer. When one reads the literature on the successful inhibition of tumor induction and growth by dietary control, one becomes acutely aware of the paucity of information in this field in relation to its demonstrated importance. Very little is known regarding the existence of any specific nutritional requirements of any kind of tumor, except the hepatoma in the rat, where diet exerts a very significant effect. In view of the fact that specific dietary factors are required for the maintenance, reproduction, and growth of normal cells and that the metabolic pattern of malignant tissue is quite specific and may be found to be more so, it would seem to be advisable to cultivate this field intensively in man as well as animals.

The natural resistance or immunity of certain tissues. One of the most provocative phenomena in the field of cancer is the natural resistance of certain tissues to the natural development of cancer and the acceptance of metastases. Striated muscle, heart muscle, spleen, kidney, and intestinal mucosa are particularly resistant to the development of malignant tumors. In lower forms this applies also to the mucosa of the glandular portion of the stomach. The natural resistance of these tissues has rendered it very difficult for the geneticist to render them susceptible. Yet, we know that tumors of all these organs do occasionally occur, and particularly so in the stomach and large intestine of man. We have no rational notion for the explanation of this natural resistance even in the presence of high-grade susceptibility in other organs. It is not due to a natural resistance to the transplantation of an homologous tissue because thyroid, bone, and other tissues have been transplanted into the spleen and striated muscle.

It is possible to render an animal immune to grafts from another animal (heterologous grafts) depending on the natural resistance of the host and the malignancy of the tissue to be transplanted. This is particularly true when a graft has regressed or, after "taking," has been destroyed by X-ray treatment. But up to the present time no one has demonstrated antibodies to cancer tissue in the serum of the host or has been able to demonstrate in a host immunity to a graft of its own cancer (*1*, *17*).

However, immune reactions have been obtained from the serum of a host with a heterologous transplant and have been explained as due to heterologous tissue proteins (*17*). (It would seem that in such a case the proliferative power of the transplant must be such as to annul any injurious effect of the antibodies, if they have an injurious effect.) The failure to obtain evidence of antibodies in the serum of animals with malignant tumors is consonant with the chemical similarity of proteins in malignant tissue and the normal tissue from which it came (*7*). Antigenically, a crystalline enzyme isolated from the Jensen rat sarcoma was the same as that from rat muscle (*16*). On the contrary, it has been reported that a cathepsin containing protein isolated from a hepatoma (rat) is antigenically more similar to one isolated from a Jensen sarcoma (rat) than that isolated from the normal liver (*18*).

It is discouraging to read the literature dealing with the immunology and serological diagnosis of cancer. Ehrlich (*4*), who worked with the problem for 15 years, is said to have become so discouraged that he stated: "Until some fundamental discovery has solved the mystery of life itself, our knowledge of cancer will not advance a single step." Although an attempt such as Ehrlich made to immunize the body against cancer by inducing resistance against transplantable cancers may not be achieved, work using the new methods for isolating protein and the newer knowledge and techniques of immunochemistry should be applied. At the same time the possibility of developing a method for the serodiagnosis of early cancer should not be overlooked, even though it may be grossly empirical.

The need of a simple test for the diagnosis of early internal cancer is urgent. Cancer of the alimentary tract ranks first as a cause of death from cancer. Cancer of the stomach ranks first in men and second in women. Cancer of the stomach is "silent" or produces no symptoms in 25–30 per cent of autopsied persons dying of the disease (*14*). In fact, the evidence indicates that the disease is overlooked in 50 per cent of the cases which are attended at our best general hospitals, for the incidence of gastric cancer, according to mortality statistics, is 16 per cent of all cancers, and the incidence, according to the records of general hospitals is only from 6 to 8 per cent of all cancers. (Any challenge of these data, which I admit may be in error, simply indicates that we need to increase the descriptive science of the disease.) Not only does a large percentage of silent cases exist, but at least 20 per cent of people die of a surgically resectable cancer or without metastases beyond the adjacent lymph nodes (*22*). The surgical mortality from gastric resection has been reduced to such an extent that it is now possible to state that if we had some simple method for the diagnosis of early gastric cancer, the mortality from this disease could be reduced by from 30 to 50 per cent, and perhaps even more.

The effect of cancer on the host. If early cancer cannot be diagnosed by some serological method, some effect of the cancer on the host may be found before metastasis occurs or after it has occurred to the immediately adjacent lymph nodes, as in the case of the phosphatase test for cancer of the prostate. In fact, the success of this test provides renewed hope that a test or tests for other internal cancers may be found.

The most striking early effect of a cancer on the biochemistry of the host that seems to be established is the reduction of renal and hepatic catalase. The catalase in the erythrocyte is unaffected. This appears to be specific for a malignant tissue, since it is common to malignant tumors and since the phenomenon does not occur in pregnancy or in the presence of embryonal transplants. According to Greenstein and Andervont (*8*), the liver catalase is significantly reduced in four days after transplantation of a sarcoma in the tail of a mouse. Whether the reduction in renal and liver catalase is unique for a malignant process and what causes it is uncertain.

I select this example of the effect of a malignant tumor on its host only to emphasize that such an approach to the diagnosis of cancer is feasible and, if successful, should contribute greatly toward facilitating the case-finding of internal cancer. There are other leads with promise. In fact, it is improbable that a single diagnostic method for all t[illegible] cancer will be found. Several methods may ha[illegible] used in a case-finding program.

TABLE 1

SHOWING THAT PRIMARY CARCINOMA OF THE LIVER IS EQUALLY DISTRIBUTED BETWEEN WHITES AND NEGROES AT COOK COUNTY HOSPITAL, CHICAGO, WHERE ONE-THIRD OF THE AUTOPSIES ARE ON NEGROES*

	White	Colored	Total	Per cent of total
Cancer with cirrhosis	22†	10‡	32	44
Cancer without cirrhosis	26§	14§	40	56
Totals	48	24	75	

* Data supplied by Dr. Hans Popper.

† All males.

‡ Three females.

§ Males predominate.

We should remember that the matter of diagnosis will still exist after a cure is found and that we now have the cure for many early cancers.

Man is at present an experimental subject for the study of cancer, as various investigators have pointed out. He is inclined to experiment on himself and produce disease that he might otherwise avoid. Hence, reliably collected and analyzed statistics should provide valuable information regarding the cause and prevention of cancer—particularly cancer of the stomach. For example, present statistics indicate that cancer of the stomach occurs twice as frequently in the Dutch as in the British. Is this true? And, if so, what is the cause? It has been ascribed to the greater consumption of irritants in the food and drink by the Dutch. The evidence is equivocal (*12*). The same situation obtains for the Chinese in Java who have a higher incidence of cancer than the native Javanese who have a low incidence (*12*). Statistics from England indicate that the incidence of cancer of the stomach is higher in the lower- than the higher-income group (Stevenson, 1921). Taking another internal cancer, the autopsy incidence of primary cancer of the liver in the South African Bantu is 37.5 per cent (*15*). In the West African Negro the disease represents 18.7 per cent of all deaths from cancer. In European countries cancer of the liver makes up only 1.1 per cent of all cancer deaths. Statistics from the Cook County Hospital, Chicago, show that this marked difference in the incidence of primary cancer of the liver between whites and Negroes can hardly be due to a genetic difference. At autopsy primary cancer of the liver constitutes 1.1 per cent of all cases of cancer as in Europeans, and the incidence is the same in the whites and Negroes (see Table 1). Such observations strongly indicate that extrinsic factors are concerned in the genesis of cancer of the stomach and liver. This should warrant and stimulate a thorough search among foods and drinks for carcinogenic agents. An agent in heated fats and something produced by heating cholesterol have been shown to cause sarcoma occasionally when injected subcutaneously in mice or rats. Nevertheless, it has not been established that the feeding of heated fat, cholesterol, or irradiated cholesterol will cause cancer of the stomach in the experimental animal. However, P. R. Peacock (*23*) observed a cancer of the stomach to develop in one of 6 rats when some croton oil was added to heated (350°C.) cotton-seed oil. The fact that one can demonstrate carcinogenic substance in heated fats (to the point of browning) by subcutaneous injection should render them suspect when taken daily over years. We should recall that in the case of gastric cancer in man we are looking for the cause of a disease which occurs only in approximately 1 out of 750 persons above the age of 40 (*13*). Also, a long latent period can be anticipated because a feeble carcinogen must act over a long period to induce a tumor—perhaps 30 years or more in man. The story of the experimental demonstration of the carcinogenic activity of tar should suffice to illustrate this point. Tar is a feeble carcinogen compared to the benzpyrene which was extracted from it.

I have taken advantage of this occasion to give special mention to the problem of gastric cancer because it heads the list of the organ sites for cancer in man. We know less about its cause and diagnosis than any of the external cancers. Gastric cancer has been neglected by the investigators in the field of cancer probably because it has not been easy to produce by genetic procedures and exogenous carcinogens.

In view of the progress in the basic knowledge of cancer made during the last 20 years and the availability of new chemical and physical tools, and the fact that funds appear to be forthcoming for an attack on all fronts, the possibility of great discoveries being made in the next 10 or 20 years looks very encouraging.

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Recent Changes in Sedimentation in the Gulf of Mexico

Parker D. Trask, Fred B. Phleger, Jr., and Henry C. Stetson[1]

THAT SEDIMENTS IN THE GULF OF Mexico have changed materially in relatively recent time has been established by a recent expedition of the *Atlantis*, the oceanographic research vessel of the Woods Hole Oceanographic Institution. Deposits clearly associated with the Ice Age lie within a foot or two of the surface of the sea floor over a large part of the Gulf.

The *Atlantis* spent the months of February and March 1947 in the northwest part of the Gulf of Mexico, primarily for the purpose of investigating the environmental conditions of deposition of sediments. The expedition was sponsored jointly by the Woods Hole Oceanographic Institution and the Geological Society of America. The latter contributed a grant of $14,500 for this purpose to the authors of this communication, while the Oceanographic Institution supplied the vessel, crew, and scientific personnel for the expedition and made available laboratory facilities and personnel for working up the results.

Despite considerable rough weather, the expedition was remarkably successful. Some 550 short cores of the bottom sediments, ranging in length from 5 to 50 cm., and 100 long cores, ranging in length from 1.5 to 3.3 m., were collected. Twelve lines of samples transverse to the coast across the continental platform from the mouth of the Rio Grande to the mouth of the Atchafalaya River, and 7 lines across the continental slope out to the deepest part of the Gulf, were taken. In addition, about 100 stations were occupied for plankton tows, serial temperature, and samples of water. Several hundred temperature-depth records were made with a bathythermograph along the lines of traverse, and continuous depth records were made with a recording fathometer. The material collected is now being actively worked up at the Woods Hole Oceanographic Institution. The U. S. Bureau of Mines Experimental Station at Pittsburgh, Pennsylvania, through the courtesy of H. M. Cooper, supervising chemist of the Coal Analysis Section, is cooperating in this work by making analyses of the organic content of the sediments.

A preliminary examination of 12 long cores distributed representatively throughout the off-shore waters of the Gulf shows two distinctly different layers of sediment: (1) an upper zone of globigerina ooze, rich in calcium carbonate, 5–50 cm. in thickness, and (2) a lower zone of alternating bands of clay and extremely well-sorted, fine-grained silt, relatively poor in calcium carbonate. Although in a few places the two zones are separated by a layer of red clay or red mud of intermediate calcium carbonate content, in most cores the transition from alternating clay and silt to globigerina ooze is fairly abrupt. Cores from the area off the Rio Grande contain a few centimeters of foraminiferal ooze at the top, below which is fine silt extending to the bottom of the core. No alternating bands of clay and well-sorted silt have been noted in this area.

The lower zone of banded clay found throughout most of the Gulf consists of alternating layers of clay, 1 mm. to 30 cm. thick, and of silt, 0.2 mm. to 5 cm. in thickness. Most of the clay bands are 1–2 cm. thick; most of the silt bands, less than 1 mm. The silt is so well sorted that under a high-power binocular microscope it has the appearance of ordinary beach sand. Its average (median) diameter is estimated to range between 10 and 20 μ. Such good sorting in such a fine silt is most unusual.

Well-defined cross-bedding was noted in two cores: one, at a depth of 170 cm. beneath the sea floor in a sample taken from a sea mount near the edge of the continental platform, and the other, 50 cm. beneath the sea floor in the abyssal deep near the edge of the continental slope off Campeche bank, north of the Yucatan peninsula. In the sample from the deep off Campeche bank, the false-bedded zone is 5 cm. thick, individual layers dipping up to 15°. The core there was not deformed, and the attitude of the bedding must be regarded as genuine.

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One core (No. 143), taken in 3,546 m. of water in the middle of the Sigsbee deep in the deepest part of the Gulf, has been examined for Foraminifera. The upper foraminiferal zone, 50 cm. in thickness, is characterized by a subtropical planktonic fauna, dominated by *Globigerinoides rubra*, *Globorotalia menardii*, *G. tumida*, *G. truncatulinoides*, and *Pulleniatina obliquilata*. Between depths of 50 and 68 cm., in a zone of red clay or red mud, the fauna is transitional between cold- and warm-water forms. Between depths of 74 and 78.5 cm., at the top of the zone of banded clay and silt, the fauna is definitely sub-Arctic and is dominated by *Globigerina bulloides*, *G. pachyderma*, and small specimens of *Globigerinoides rubra*. Between 78.5 and 125 cm., the fauna is cold-water in type but is warmer than that between 74 and 78.5 cm.; and from 125 to 168 cm., at the bottom of the core, the fauna is definitely sub-Arctic. Abundant broken and seemingly eroded specimens were noted between 74 and 78.5 cm., 92 and 96 cm., and 113.5 and 116.5 cm.

A series of submerged hills rise above the sea floor near the outer edge of the continental platform, just inside the 100-fathom line, off the Louisiana coast between the Sabine and Atchafalaya Rivers. Two of these hills, lying within 10 fathoms of the surface, located in N. Lat. 27° 52.5′, W. Long. 93° 49′, and N. Lat. 27° 54.5′, W. Long. 93° 36′, were studied in some detail. The fathometer trace shows that they are remarkably flat on top and that they rise rather abruptly 300–400 feet above the surrounding muddy plain. On the side of one of these two hills the depth changed from 51 to 86 fathoms within a few ship lengths.

The sediments in these areas are influenced materially by the change in topography. The flat continental platform is underlain by sandy silt; the slopes of the hills, by silty, calcareous sand; and the tops, by round Lithothamnium balls and little or no sandy material. The Lithothamnium balls, dredged from water up to 20 fathoms in depth, have a maximum diameter of 10 cm. and seem to be alive on all sides, which suggests that they are rolled around by the waves or currents. In one place in 9 fathoms of water, several genera of corals, similar to common West Indian genera, were found with these balls.

The origin of these hills arouses speculation. Shepard (*2*) has suggested that they are salt domes. Trowbridge (*3*) also has noted calcareous sediments on the side of a "salt" dome on Southwest Pass. The distribution of sediments and the topographic relations, however, suggest bioherms or calcareous reefs described by Cummings and Shrock (*1*) from the Silurian of Indiana and Wisconsin. The hills perhaps may be erosional remnants, but, if so, either they must have been eroded prior to the deposition of the sandy silt forming the present continental platform or the hills protruded far enough above the surrounding flat, muddy plain to afford a place where calcareous organisms could live. The hills also conceivably could be associated with diastrophic deformation of the Gulf of Mexico basin.

The conditions of sedimentation obviously have changed profoundly in relatively recent geologic time. The upper zone of globigerina ooze, rich in calcium carbonate and characterized by a warm-water fauna, points to subtropical conditions similar to those now prevailing in the Gulf. The intermediate zone of red clay or red mud, noted in a few samples, is intermediate in carbonate content and contains a transition fauna between warm and cold. The lower zone, poor in calcium carbonate, and characterized by a cold fauna and alternating bands of clay and well-sorted silt, indicates the effect of the glacial epoch. The sediments in this bottom zone in general are essentially unchanged to the bottom of the deepest core, 250 cm. beneath the surface of the sea floor. Seemingly, therefore, only one major glacial epoch is represented.

The explanation of (1) the well-sorted, fine silt bands, (2) the layers of broken Foraminifera, and (3) the false bedding at depth in the cores offers a challenge to the imagination. Obviously, the water must have been in motion at the time of the development of the cross-bedding and also, perhaps, when the Foraminifera were broken. The false bedding, owing to the small dimensions of the core, conceivably could represent ripple marks, but, even if that is true, the bottom water must have been in motion to form ripples. How, then, could one account for deep movement of water according to prevailing notions of the sea—by tidal currents, internal waves, or deep currents? Roughness of the sea floor, just as roughness of land affects wind, must interfere with the movement of deep layers of water. But was the sea floor rough at the time of deposition of the false bedding? Perhaps the explanation lies (1) in lowering of the sea level because of removal of water during the ice age, (2) in submarine slumping, or (3) in recent deformation of the floor of the Gulf. The presence of the numerous well-sorted silt layers 200–300 miles from the present shore poses a real problem of transport. It is possible that these layers resulted from eolian action in the final stages of the ice epoch, when so much loess was being deposited. They also might have been laid down near shore. If so, our ideas of the magnitude of ocean changes in the late Pleistocene are likely to be materially different from those we have held in the past.

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Obituary

Charles Atwood Kofoid

1865–1947

In the span of his life from October 11, 1865, to May 30, 1947, Charles A. Kofoid made contributions of outstanding and enduring value to biology and education. His scholarly enthusiasm left on a large number of younger biologists an impression that will influence them throughout their lives. He was an eager student of nature, a wise counselor and friend of a large number of undergraduate and graduate students, and a collector of books who had a real love for his acquisitions. He was an industrious investigator and reader and was the author of more than 200 original publications as well as several thousand reviews and abstracts. He was associated with the editing of many journals. Few who have devoted themselves to careers of creative activity and influence have been able to accomplish more than he did.

Kofoid was born at Granville, Illinois. After his courses at Oberlin were completed in 1890, he went to Harvard for graduate work. His Ph.D. thesis, completed in 1894, was a study of the early development of *Limax*, in which E. L. Mark had guided him.

The first position Kofoid had in biology was at the University of Michigan. While there, he became interested in protozoa through association with H. S. Jennings. In 1895 he was appointed to the staff of the Illinois State Laboratory of Natural History as superintendent of the Illinois Biological Station. His studies of the plankton of the Illinois River were continued for five years. In 1900 he became a member of the Department of Zoology at the University of California; and from 1910 until his retirement in 1936, except for a period of four years, he was chairman of that Department.

After Kofoid went to California, the interest in plankton that he had developed in Illinois was transferred to the ocean. In carrying on that research he took an active part in the development of the Marine Biological Station of San Diego, now the Scripps Institution of Oceanography. His investigations of plankton organisms, which were collected there and when he was naturalist on the Alexander Agassiz expedition to the eastern tropical Pacific, were reported in numerous papers and ultimately in several large monographs on tintinnids and dinoflagellates. He also made some studies of dinoflagellates at the Naples Zoological Station and, when serving as Rockefeller Foundation visiting professor to Tôhoku Imperial University, at the Asamushi Biological Station in Japan.

At the time of Kofoid's trip to Ceylon in 1915 and 1916, he had become interested in intestinal protozoa and parasitology in general. He brought back ciliates from cattle and elephants, and ultimately monographic reports were prepared on them. In World War I he was commissioned major in the Sanitary Corps, engaged in a hookworm survey in Texas, and was in charge of an Army parasitological laboratory in New York City. After his return to Berkeley, he entered upon a period of intensive parasitological research. He served at one time as director of the Parasitological Division in the California State Board of Health; he conducted a laboratory making systematic examinations of persons for intestinal parasites; and he was responsible for the publication of a long series of papers on flagellates, amoebae, and ciliates of man and other animals, including termites. He was deeply concerned about public health matters, and at the end of 1921 was much interested in the possibility of going to India to occupy the chair of protozoology at the proposed Bombay School of Tropical Medicine.

Kofoid took a leading part in various undertakings in which he was able to contribute directly to public interest and welfare. At the time of his first trip to Europe he prepared an extensive report on biological stations at the request of the U. S. Bureau of Education. When he went to Ceylon and Japan, he investigated pearl culture for the U. S. Bureau of Fisheries. For many years he examined plankton from reservoirs of the San Francisco water supply, to detect and control organisms that cause tastes and odors. He directed biological studies in two cooperative projects concerning damage to wooden structures: one, that done by marine borers in San Francisco Bay and elsewhere, the other, that done by termites on the Pacific Coast. He also cooperated with the dental profession in the study of protozoa of the human mouth.

A few months before his death Kofoid turned over to the University of California his large library, accumulated jointly by himself and his wife. The collection includes 44,130 volumes not previously in the University Library. Among the books are 11,400 rare volumes in the history of science and medicine, and a complete set of all the editions of Darwin's works. His collection of reprints, which is especially complete in the subjects of protozoology and parasitology, numbers approximately 70,000.

Kofoid's professional achievements and personal distinction were recognized by election to many honorary scientific societies, including the National Academy of Sciences; by election to fellowship and to office in various organizations; by the award of diplomas and medals; by the granting of honorary degrees by Oberlin, the University of Wales, and the University of California; and by innumerable personal and individual expressions of regard from colleagues and associates. At the time of his retirement he was given a volume of letters and manuscripts expressing appreciation from the many students who had taken the doctorate with him. A volume of the *University of California Publications in Zoology*, of which he had been an editor for 25 years, was dedicated to him. On his 80th birthday the Department of Zoology held in his honor a social meeting in his library, which occupied one of the stacks of the Biology Library in the Life Sciences Building.

Kofoid had accumulated an estate of some size. Almost all of this was left, approximately equally divided, to the University of California and the Pacific School of Religion. He intended that the gift to the University should be used to provide scholarships for graduate students, preference being given to married students. By this fund and the gift of his library he established in the University where he had spent most of his life a continuing influence of his devotion to scholarly and creative activity.

HAROLD KIRBY

University of California, Berkeley

Association Affairs

Historical Sketch of the Association

The American Association for the Advancement of Science was organized in 1848. It is the oldest general, national scientific society on this continent. For almost a century it has kept faith with its founders and has fulfilled with ever-increasing success the high purposes for which it was established.

In 1848, when the Association was organized, science consisted of two general divisions, *natural philosophy* and *natural history*, the former including the physical sciences then existing, and the latter the biological. In fact, the Association succeeded a society organized in accordance with this division of the sciences, viz., the Association of American Geologists and Naturalists, which was the culmination, in 1842, of several abortive attempts to establish a national scientific society.

The Association now has 15 sections and 202 affiliated and associated societies that together cover practically all the various fields of pure and applied science. True to the spirit that inspired its organization, the Association has continued to be an integrating factor in this growing diversity. It is a federation of various scientific organizations and disciplines which, in the long run, will prove to be among the most important forces affecting our civilization. It is demonstrating that the whole of science is greater than the sum of its parts. Perhaps the Association is rendering its greatest service to science, and to mankind in general, by providing opportunities for its professional members to consider their special subjects in the general setting of science as a whole, and to reflect on its effects upon the problems of this world.

The history of the Association shows a steadily increasing membership during the trying periods of both world wars. Even the disruptions of the greatest war in the history of mankind have not retarded its growth or impaired its vitality. The Association now has more than 33,000 members, and the membership of its affiliated societies (including duplications) is probably a million. Membership in the Association is open not only to professional scientists but also to other persons who find in science pleasure, adventure, and opportunities for service to humanity. Professional scientists have joined the Association because of the broad scope of its scientific interests, because of its journals and other publications, and perhaps even more because of the opportunities it offers for coordinating and integrating the natural sciences with social progress. Other persons have joined the Association in order to maintain contact with the great scientific currents that are sweeping humanity onward.

The annual meetings of the Association are the largest general meetings of scientists in the world. On no other occasion do men having such varied scientific interests assemble to discuss their specialties and to learn how much they have in common. With few exceptions during the period of the Civil War and World War II, the AAAS has held at least one meeting in each of its 99 years, the present one in Chicago being the 114th. The Pacific and Southwestern Divisions have held 50 meetings.

In addition to conducting meetings and conferences of those interested in the various branches of science and education, the Association edits and publishes two journals, publishes and distributes technical symposium volumes, administers gifts and bequests, provides support for research, arranges awards for scientific achievements, cooperates with other organizations for the advancement of science, and engages in other activities authorized by the Council.

The Council consists of the President, the vice-presidents of the sections, the Administrative Secretary, the General Secretary, the secretaries of the sections, the Treasurer, the members of the Executive Committee, a fellow elected by each of the two regional divisions of the Association, two fellows named by each affiliated society having more than 100 members who are fellows of the Association, one fellow named by each of the other affiliated societies, and one fellow from each affiliated academy of science. There are members of the Council representing every major field of science and interest of the Association.

A large majority of members of the Council are elected by the sections and the affiliated societies, which are entirely independent of the Executive Committee and the general officers of the Association.

It would be difficult to lodge the power of a national organization in a more representative and democratically elected body than the AAAS Council.

Not only are members of the Council democratically elected, but they represent all the special fields of science of the 115 societies which appoint them. The Council has fulfilled its obligation to speak on behalf of scientists on many occasions, most recently on legislation affecting a proposed National Science Foundation.

As the products of scientific minds exert more influence in world affairs, the responsibilities of the Association increase. With firm purpose it is serving to facilitate cooperation among scientists, improve the effectiveness of science in the promotion of human welfare, and increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

[This sketch will appear in the General Program for the Chicago Meeting.]

NEWS *and Notes*

The First International Salon, "Photography in Science," sponsored by *The Scientific Monthly* and the Smithsonian Institution, is under way. For judging on October 27 competitors from 30 states and three foreign countries submitted 361 prints—243 in the black-and-white division and 118 in the color division. Most of them are being shown during November in the northwest gallery of the Arts and Industries Building, Smithsonian Institution. They will be shown again at the International Science exhibition, Chicago meeting of the AAAS, December 26 through 31. Later they may be seen at the Buhl Planetarium, Pittsburgh, and at the Cranbrook Institute of Science, Bloomfield Hills, Michigan.

The prints exhibited show novel application of photography in physical and biological research and excellent examples of photography for conventional scientific purposes. In the color division first place was awarded to Thomas C. Poulter, Armour Research Foundation; second, to Albert M. Stover, Glenn L. Martin Company; third, to Ralph O. Marts, Forest Products Laboratory. In the black-and-white division first place went to Edwin R. Willis, The Ohio State University; second, to V. P. Hollis, University of Minnesota; third, to H. U. Rhoads, Lambert Pharmacal Company.

Five entries were awarded honorable mention in each division: color—Jane K. Glaser, Argonne National Laboratory; Inez V. deGruy, Southern Regional Research Laboratory (two entries); Alice Elizabeth Sutherland, Callaway Mills; Bradford B. Underhill, Pennsylvania State College; black-and-white—Frank H. J. Figge, University of Maryland, and Thomas Carver, Harvard University, collaborating at Woods Hole; H. Lou Gibson, Eastman Kodak Company; F. A. Hamm, General Aniline & Film Corporation; Cornelius B. Philips and N. J. Kramis, Rocky Mountain Laboratory; Robert Schrek, Veterans Administration Hospital, Hines, Illinois.

Under the same auspices and title the Second International Salon will be held in Washington, D. C., in September 1948, in connection with the Centennial Meeting of the AAAS, September 13 through 18.

About People

Paul M. Gross, head, Department of Chemistry, and chairman, Research Council, Duke University, has been appointed dean of the Graduate School, succeeding **Calvin B. Hoover,** who will continue as chairman, Department of Economics.

Charles H. Philpott, principal, Harris Teachers College, St. Louis, Missouri, has been appointed director of education in charge of curriculum research and development, St. Louis Public Schools.

Carl F. Cori and his wife, **Gerty T. Cori,** both professors of biochemistry, Washington University School of Medicine, and co-winners of the 1947 Nobel Prize in Medicine, will present the third Harrison Howe Lecture sponsored by the Rochester Section, American Chemical Society, in the Rochester Chamber of Commerce building, November 17, on the topic, "The Mechanism of Enzymatic Synthesis of Polysaccharides."

James A. Baker, associate, Department of Animal and Plant Pathology, The Rockefeller Institute for Medical Research, has been appointed professor, Department of Pathology and Bacteriology, New York State Veterinary College.

John S. Nicholas, Sterling professor of biology, and chairman, Department of Zoology, Yale University, has been appointed director of the Osborn Zoological Laboratory, succeeding **L. L. Woodruff,** who died last June.

Otto A. Bessey, chief, Division of Nutrition and Physiology, Public Health Research Institute, New York City, has been appointed professor of biochemistry, and head, Department of Biochemistry, University of Illinois. He will assume his new duties on March 1, 1948.

Robert V. Drexler has been named Bert Heald Bailey professor of biology, and head, Division of Biology, Coe College, Cedar Rapids, Iowa.

Paul Kiernan, head, Section in General Surgery, Mayo Clinic, has been appointed associate professor of surgery, Georgetown University School of Medicine, Washington, D. C.

Daniel M. Popper, formerly of the staff of the Yerkes and McDonald Observatories, Universities of Chicago and Texas, has been appointed assistant professor of astronomy, University of California, Los Angeles.

J. Robert Oppenheimer, director, The Institute for Advanced Study, Princeton, New Jersey, will deliver the 1947 Arthur Dehon Little Memorial Lecture on the topic, "Physics in the Contemporary World," in Morss Hall, Walker Memorial, Massachusetts Institute of Technology, at 8:30 P.M., November 25.

The Lectureship, established in 1944 with funds donated by Arthur D. Little, Inc., in memory of its founder, was inaugurated last year by Sir Edward V. Appleton, who spoke on "Science, Government, and Industry."

Haven Emerson, emeritus professor of public health practice, Columbia University School of Public Health, will deliver the Cutter Lecture on Preventive Medicine in Amphitheatre D, Harvard Medical School, November 24 at 5:00 P.M. Dr. Emerson will speak on the topic, "Whither the Pegasus of Public Health?"

Andrew C. Ivy, vice-president in charge of the Chicago Professional Colleges, delivered the annual lecture of the Epsilon Chapter, Alpha Kappa Kappa, given in memory of George A. Ulrich, clinical professor of obstetrics, Jefferson Medical College of Philadelphia, at the College on October 20. Dr. Ivy's subject was "Experiments in Resuscitation From Asphyxia."

Visitors to U. S.

S. C. Pan, a member of the faculty of National Chungking University, Chungking, China, who has been appointed a Seagram International Fellow, will soon come to this country as a visiting professor in the Joseph E. Seagram & Sons program.

Cenek Adamec and **Ivan Viden,** staff members of the Czechoslovak Institute of Public Opinion, are in this country under a grant from the Rockefeller Foundation to study various aspects of poll interviewing. Their itinerary includes the American Institute of Public Opinion, where they have been working with George Gallup, the Statistical Laboratory at Iowa State College, the University of Michigan, Harvard University, and Columbia University.

Grants and Awards

Charles R. Hook, president, American Rolling Mill Company, Middletown, Ohio, has received the 1947 Medal for the Advancement of Research from the American Society for Metals. The medal, first awarded in 1943 to Roy A. Hunt, president, Aluminum Company of America, has been won in succeeding years by Robert C. Stanley, president, International Nickel Company; Gerard Swope, General Electric Company; and Rufus E. Zimmerman, vice-president, U. S. Steel Corporation of Delaware. The medal, plaque, and citation were awarded at the annual banquet of the Society held in Chicago October 23, during the National Metal Congress and Exposition.

The American Society of European Chemists and Pharmacists, an association of scientists who have been graduated from European universities, at a meeting held in New York on November 5 presented to **Carl Neuberg,** research professor of chemistry at New York University, the newly established Carl Neuberg Medal for scientific achievement. Dr. Neuberg, who was born in Germany in 1877, is author of almost 1,000 publications and founder of *Biochemische Zeitschrift*, of which he was editor from 1906 until 1936. He was at one time director of the Kaiser Wilhelm Instituts for Experimental Therapy and for Biochemistry.

Howard G. Swann, associate professor of physiology, University of Texas Medical Branch, has received a grant of $12,500 from the AAF Laboratories for the support of research on resuscitation.

Harlow Shapley, director, Harvard College Observatory, has been awarded the Gold Medal of the Indian Association for the Cultivation of Science. The presentation was made by S. K. Banerji, member of the Governing Board of the Association, at the 95th National Meeting of the American Meteorological Society, held jointly with the American Geophysical Union's New England Meeting, September 18, at the Institute of Geographical Exploration, Harvard University.

Smith, Kline & French Laboratories, Philadelphia, has made a grant to **Stanley C. Harris,** professor of pharmacology and physiology, Dental School, Northwestern University, to enable him to conduct research on the pharmacology of analgesia and anorexia in the Dental and Medical Schools of Northwestern. **Clement A. Finch,** Harvard Medical School, has also received a grant for the support of research to be done at the Peter Bent Brigham Hospital, Boston, under the supervision of George W. Thorn, of Harvard Medical School.

The University of Michigan has received a grant of $8,500 from Parke Davis & Company, Eli Lilly & Company, Abbott Laboratories, and the Upjohn Company to permit completion of experimental research and investigation of the synthesis of penicillin and related compounds. This research is under the direction of **Werner E. Bachmann,** professor of organic chemistry at the University.

The James F. Lincoln Arc Welding Foundation has recently announced the rules of its Annual Engineering Undergraduate Award and Scholarship Program. Resident engineering undergraduate students registered in any school, college, or university in the United States which offers a curriculum in any branch of engineering (including agricultural engineering) or architecture leading to a degree, and cadets registered in the U. S. Military, Naval, and Coast Guard Academies, are eligible to submit papers dealing with design for arc welding of parts of machines, complete machines, trusses, girders, structural parts, or their maintenance. It is not necessary that the machine, structure, or part, be actually built, but the design or method of construction must be described in the paper. Papers must be mailed by May 15, 1948. A total of 77 awards are offered, the highest being $1,000; the next highest, $500; and the third highest, $250. Four awards will be given of $150 each, 8 of $100 each, 12 of $50 each, and 50 of $25 each. The departments in the institutions in which the three highest awards are made will receive amounts of money equal, respectively, to those awards, to be used as scholarships within the departments. Further information may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Whittlesey House and *Science Illustrated* have announced the Second Biennial Prize Contest for books on scientific subjects written for the layman. First prize is $3,500; second prize, $1,000; third prize, $500. In addition, a $1,000 advance against royalties will be given to each of the prizewinners and also to each additional author whose project is accepted for publication. The contest opens December 1, 1947, and closes November 1, 1948. Manuscripts must be completed by November 1, 1949, and range in length from 80,000 to 150,000 words. The contestant must submit by November 1, 1948, a complete plan for the book, with 15,000 words of the manuscript, and a detailed account of the amount and kind of research he intends to do. He must also supply two typewritten recommendations, one professional and one personal, plus an autobiographical sketch of at least 250 words. All entries must be typed in English, double-spaced, and the original typescript should be submitted to Beulah Harris, Science Editor, Whittlesey House, 330 West 42nd Street, New York 18, New York.

Judges for the contest will be: Harlow Shapley, director, Harvard College Observatory; C. C. Furnas, director, Aeronautical Laboratory, Cornell University, Buffalo, New York; Paul B. Sears, professor of botany, Oberlin College, Oberlin, Ohio; Gerald Wendt, editorial director, *Science Illustrated*; and the editors of Whittlesey House. The first contest, which closed November 1, 1946, was won by Clyde Kluckhohn, Department of Anthropology, Harvard University, for his manuscript, *Anthropology and the world today*.

In October 1945, Research Corporation, New York City, established the Frederick Gardner Cottrell Grants in Aid of Scientific Research, designed to assist in re-establishing academic research programs and teaching staffs disrupted during the war. The following year over 100 grants amounting to about $430,000 were approved from the fund of $2,500,000 set aside for this purpose. These grants, which are made to institutions on the basis of applications by individuals, have gone to about 30 states, Alaska, and the District of Columbia, more than half of the recipients being smaller colleges and universities. Since its founding in 1912 by F. G. Cottrell, the Corporation has awarded more than $2,000,000 to some 120 institutions. Application forms and additional information may be secured from the Corporation's offices, 405 Lexington Avenue, New York 17, or 225 Santa Monica Boulevard, Santa Monica, California.

Colleges and Universities

Savage Hall, new headquarters of the Cornell University School of Nutrition (see *Science* cover, October 10), was officially placed in service October 10 at impressive dedication ceremonies on the campus which reflected the School's key role in the world food crisis.

The event was characterized by Governor Thomas E. Dewey, who spoke at the ceremony, as "the brightest spot I know in a period when the high price and scarcity of food are uppermost in the minds of the people of the Nation and the world." He went on to say: "This is a most fortunate time for the completion of this first building of our great new Cornell School of Nutrition. Here is a happy union of university, farmer and state cooperation, all in one effort to improve the health of the American people."

Disclosing his views on the world food crisis, he asserted: "We need and want to do our honest share to feed hungry people overseas until they are better able to help themselves. We have at the same time a prior and a binding obligation to see that no American is poorly fed as a bitter result of thoughtlessness or badly planned generosity on our part."

"The farmers of our state and Nation have performed miracles at increasing production by nearly one-third over the prewar period. We can count on the farmers as always to do more than their share, and it is a matter of real gratification that the farm organizations of New York have taken such a vital interest in the nutrition of our people by contributing this beautiful new home of the School of Nutrition. . . . I am happy and proud to dedicate Savage Hall of the Cornell School of Nutrition to the better nutrition of the American people and to the science of using food for the advancement of the health, the vigor, and the good will of human beings everywhere."

Leonard A. Maynard, director of the School, stated that the new building provides greatly strengthened facilities for carrying out an over-all program of nutrition study. He added: "This gift by the farmers of the Northeast was a pioneer action—as much as the establishment of the School itself. So far as is known, no similar contribution to a university has ever been made. The action reflects the real interest of farmers in public service, their recognition of the importance of education and research and their appreciation of the interdependence of agriculture, nutrition, and health."

Before Savage Hall was built, the School had no buildings of its own. One of its laboratories was over a horse barn and the rest of its facilities were scattered in other University buildings. Now these facilities are centralized in a four-story, brick and limestone structure with 22,700 square feet of floor space and a number of fully-equipped research and student laboratories.

The School continues, however, to draw its staff and information from the Colleges of Arts and Sciences, Engineering, Agriculture, Home Economics, the University Clinic, the College of Veterinary Medicine, and the U. S. Plant, Soil, and Nutrition Laboratory, all of which contribute to an across-the-board study of nutrition that covers every phase of the broad field from the soil to the consumer's table.

In addition to Governor Dewey the principal speakers included W. H. Sebrell, of the National Institute of Health, and Congressman Clifford R. Hope, of Kansas, chairman of the House Committee on Agriculture.

Presiding at the ceremony was Arthur S. Adams, provost of the University. The building was presented to the University by Frank M. Smith, chairman, New York State Conference Board of Farm Organizations, and was accepted by Neal Dow Becker, chairman of its Board of Trustees.

At the request of the farm organizations which contributed to the building, it was named by the Board of Trustees in honor of the late Elmer S. Savage, professor of animal husbandry in the College of Agriculture. Prof. Savage had been associated with Cornell for 35 years, and in that time became one of the dairy industry's outstanding leaders. Most of his work was done in the field of dairy cattle nutrition, from which came the Cornell Calf Starter Method. One of his greatest contributions was the initiation of the widely adopted "open formula" plan for the marketing of livestock feeds.

The Medical College of Virginia was presented a portrait of Wortley F. Rudd, former dean, School of Pharmacy of the College, by the Richmond Retail Druggists Association, November 7, at the Richmond Academy of Medicine. Dr. Rudd retired July 1 after serving 27 years as dean and 43 years as a faculty member of the College. The portrait was painted by John D. Slavin of Richmond.

The University of Wisconsin has obtained a reconverted aircraft turbosupercharger of the type used to "boost" bombers to heights of some 40,000 feet during the war for use in a research program designed to develop new and better fuels and superchargers for combustion engines. The program, which is being supported by the Wisconsin Alumni Research Foundation, will be under the direction of Phil Myers and Otto Uyehara, of the engineering faculty. The temperatures resulting from the combustion which powers the rotor to 22,000 r.p.m. will be studied by the use of an electro-optical pyrometer, which the two men invented several years ago to study combustion in diesel engines. This instrument works on the principle of the "electric eye" by gauging the temperature of the rotor, or of the exploding vapor in the cylinder in the case of the diesel, by measuring the intensity of light through a quartz window.

The University of Georgia, Athens, has announced the following additions to its Department of Biology: **I. C. Kitchin,** formerly associate professor of zoology, University of North Carolina, associate professor; **Donald C. Scott,** University of Indiana, instructor; and **Charles O. Hathaway,** University of Virginia, instructor.

At the Indiana University Medical School, Indianapolis, **Randall Thompson,** formerly of the Medical College of Virginia, has been appointed chairman of a newly-created Department of Microbiology, and **Thurman B. Rice,** formerly chairman, Department of Bacteriology and Public Health, has been named chairman of the now separate Department of Public Health.

Fellowships

Kenyon Thomas Payne, graduate student, Division of Agronomy and Plant Breeding, College of Agriculture, University of Minnesota, has been appointed Conway MacMillan Memorial Research Fellow in Botany for the academic year 1947–48. This fellowship was established at the University in 1946 by Charles J. Brand, economic consultant and alumnus of Minnesota.

The Mellon Institute of Industrial Research has announced the establishment there of a research fellowship by the Fanny Farmer Candy Shops. This fellowship, headed by **M. G. Mayberry,** will carry on wide investigations relating to important basic problems in confectionery technology. The program embraces all phases of candy making, including scientific methods for the betterment of manufacturing procedures and especially for defining and controlling the texture of products.

The Life Insurance Medical Research Fund will receive applications up to January 15, 1948, for grants in aid of research on cardiovascular problems to begin in 1948. Support is available for physiological, biochemical, and pathological research which bears on cardiovascular problems, as well as for clinical investigation in this field. About $500,000 will be awarded for these grants.

Postgraduate fellowships for training in research for 1948–49 are also available, and applications will be received for these up to January 1, 1948. Preference will be given to candidates wishing to work in the broad field of cardiovascular function or disease and to those wishing to work in institutions other than the ones where they obtained most of their experience. A Ph.D. or M.D. or the equivalent is required. About 12 fellowships will be available with annual stipends of $2,500–$3,500.

Later in the year, the Fund will also offer a number of predoctoral research fellowships. Further information may be obtained from the Scientific Director, Life Insurance Medical Research Fund, 2 East 103rd Street, New York 29, New York.

Lehigh University has recently awarded 10 graduate study fellowships, four of which went to foreign students. Among the recipients are: **Frederick R. Gardner,** Queens University, Toronto, awarded the Sinclair Printing Ink Research fellowship in chemistry; **Ching-Huan Yang,** National Central University, Nanking, China, the Lawrence Calvin Brink fellowship in civil engineering; **Bernt Roald,** Technical University of Norway, Trondheim, the Roy R. Hornor research fellowship in metallurgy; **Walter E. Munz,** Swiss Institute of Technology, Zurich, the C. Kemble Baldwin research fellowship in mechanical engineering; **Helmut Tielsch,** Alabama Polytechnic Institute and University of Michigan, the New Jersey Zinc Company fellowship in metallurgy; **Charles F. Bild,** University of Virginia, and **Donald E. Knulk,** Ohio State University, the William C. Gotshall scholarships in metallurgical engineering; **Ludwig R. Kowalski,** Duke University, the Westinghouse fellowship in mechanical engineering; and **Richard C. Huyett,** Lehigh University, the Consolidated-Vultee Aircraft Corporation fellowship in mechanical engineering.

Paul A. Geary, research chemist, Smith, Kline & French Laboratories, Philadelphia, has been awarded the second Walter G. Karr fellowship to finance his postgraduate studies in physical chemistry at the University of Pennsylvania. This fellowship was established in 1946 for scientific personnel of Smith, Kline & French Laboratories who desire to continue their academic studies.

Meetings

The 1947–48 series of Laity Lectures, given by the New York Academy of Medicine, 2 East 103rd Street, New York, began October 30 with a lecture on "The Atom in Civil Life" by **Lewis L. Strauss,** member of the U. S. Atomic Energy Commission and the Naval Research Advisory Board. Succeeding lectures will include: "The Psychology of Leadership in War and Peace," George Ronald Hargreaves, formerly assistant director, Army Psychiatric Division, War Office, Great Britain, November 19; "Food and Civilization," Sir Raphael Cilento, director, Division of Social Activities, United Nations, December 17; "On Being Old Too Young," Edward J. Stieglitz, chief of medical staff, Suburban Hospital, Washington, D. C., January 22; "Perspectives in Cancer Research," Cornelius P. Rhoads, director, Memorial Hospital, New York, February 4; "Psychiatry for Everyday Needs," William C. Menninger, The Menninger Foundation, Topeka, Kansas, February 26; and "The Interrelation of Pure and Applied Science in the Field of Medicine," James B. Conant, president, Harvard University, March 11. All lectures, which begin at 8:30 P.M., are free of charge and open to the public.

The American Mathematical Society will hold its 429th meeting at Washington University, St. Louis, Missouri, November 28–29. Sessions will begin at 10:00 A.M. Friday and will continue through Saturday morning. **Marshall Hall,** Ohio State University, will speak Friday morning on the topic, "Foundations of Geometry, Retrospect and Prospect." At 9:00 A.M. Saturday, **Szolem Mandelbrojt,** Collège de France and Rice Institute, will speak on "Analytic Continuation and Infinitely Differentiable Functions, a General Principle." A dinner will be held Friday at 6:30 P.M. in the McMillan Hall dining room.

The American Society of Mechanical Engineers will meet December 1–5 in Atlantic City, New Jersey, with headquarters at Chalfonte-Haddon Hall. Among the ASME guests will be **David Lilienthal,** who will speak at a nuclear energy luncheon on December 2; Fred S. McConnell, president of the National Coal Association, who will address a fuels dinner Tuesday evening on "The Coal Industry Looks Ahead"; and E. O. Shreve, president of the U. S. Chamber of Commerce, who will participate in an education session on the afternoon of December 1.

In addition to nuclear energy, a second featured topic will be rocket research. In several sessions co-sponsored with the American Rocket Society, an affiliate of the ASME, the topic will be discussed by Clark B. Millikan, director of the Guggenheim Aeronautical Laboratory, California Institute of Technology, giving special attention to a review of the 10 years of research at the Laboratory, and Werner von Braun, technical director of Germany's Peenemunde Rocket Research Base during the war, who will speak on the development of the V-2 missile. A trip has been arranged to the Atlantic City Naval Air Station for demonstrations of rocket-assisted take-off, flights of A.S.F. and naval jet-propelled aircraft, and static firing of a liquid fuel rocket engine. Exhibitions of equipment and material in the fields of jet propulsion, gas turbines, and nuclear energy have been invited from the war, navy, air, engineering, and scientific branches of the Government and industry.

Sessions have also been scheduled on machine design, metals engineering, railroads, fuels, safety, process industries, power test codes, rubber and plastics, wood industries, petroleum, aviation, power, oil and gas power, hydraulics, and industrial instruments and regulators.

The American Academy of Pediatrics will hold its annual meeting December 9, in Dallas, Texas. The program will be devoted to three papers outlining the findings to date of the Academy's two-year Study of Child Health Services in Alabama, Illinois, Montana, New Hampshire, New Mexico, North Carolina, Oregon, District of Columbia, and Maryland. Warren R. Sisson, chairman, Committee for the Study of Child Health Services, will discuss "the total volume of medical care to children, based on an analysis of eight selected states." John P. Hubbard, director of the Study, will present a paper on "a review of private practice pediatricians and general practitioners." "Facts and figures on pediatric education" will be presented by John McK. Mitchell, who has conducted the study of pediatric education through personal visits to all approved medical schools in the United States and two in Canada.

A Symposium on Northern Arizona Geology was held at the Museum of Northern Arizona, Flagstaff, on August 26. Participants were 7 graduate students in geology who spent the summer in northern Arizona working under the supervision of Edwin D. McKee, assistant director of the Museum.

The program included: "Geology of the North End of the Verde Valley," Richard Mahard, of the faculty of Dennison University, now studying at Columbia; "Upper Jurassic Stratigraphy of Black Mesa," John Harshberger, University of Arizona; "Ecology of a Permian Fauna at Walnut Canyon and Bottomless Pits," Halka Pattison, Stanford University; "Fauna and Stratigraphy of the Fort Apache Limestone," Stephen Winters, Columbia University; "Geology of Oak Creek Canyon," Brainerd Mears, Columbia University; "The Rim Rocks of Sycamore Canyon," William Price, University of Arizona; and "A Study of Pediments and Drainage Divides at Echo Cliffs," William Eames, Columbia University.

The New England Intercollegiate Field Geologists held their annual field meeting with 91 geologists participating, October 18–19 in Rhode Island, with Alonzo Quinn, chairman, Department of Geology, Brown University, as host, assisted by J. P. Schafer. A bed rock trip in the area north of Providence studied areas of the supposedly pre-Cambrian (?) Blackstone series, older plutonic rocks, Quincu granite and granite porphyry, and Wamsutta sandstone and conglomerate of Pennsylvanian age. The following day bed rock exposures in the Purgatory-Newport area, south of Providence, were studied. Glacial and shoreline features were studied by geologists led by Mr. Schafer in Exeter, along Narragansett Bay, and in the Wakefield-Watch Hill morainal area. The 1948 trip will be held in Vermont with Charles G. Doll, University of Vermont, as leader, and the 1949 trip will be conducted by Joseph Trefethen, University of Maine, at Orono.

The 50th anniversary of the founding of the Columbus Section, American Chemical Society, was commemorated at the Ohio State University on October 24 by a program on various phases of modern chemistry. Speakers included Charles Heidelberger, University of California, Berkeley; H. O. L. Fischer, Banting Institute, University of Toronto; Norman Hilberry, Argonne National Laboratory, Chicago; and Martin Summerfield, Jet Propulsion Laboratory, California Institute of Technology. Charles Allen Thomas, vice-president, Monsanto Chemical Company, St. Louis, and president-elect, American Chemical Society, delivered the address at the Fifty-Year Dinner, at which time the three remaining charter members of the Columbus Section were honored. The charter members are William McPherson, emeritus president, Ohio State University, and William Lloyd Evans and Charles W. Foulk, both emeritus professors of chemistry at Ohio State.

The International Union of Biological Sciences, financially supported by UNESCO, sponsored a symposium on the "Role of Trace Elements in Plant Physiology" at Rothamsted, Harpenden, England, November 5–6. Research workers from Australia, Denmark, Finland, France, Great Britain, Netherlands, Norway, Sweden, Switzerland, and the United States participated. A report of the symposium will be published by the Union.

NRC News

The National Research Council has announced that the Merck Fellowships, supported by Merck and Company and administered by the Council, are available for the academic year 1948–1949. This program, designed to stimulate interest in fields of study requiring knowledge of more than one science, offers fellowships to provide special training to young men and women who have demonstrated marked ability in research in chemical or biological science and who wish to broaden their fields of investigational activity. Candidates must submit evidence of training in these fields equivalent to that represented by the Ph.D. degree and must have demonstrated unusual research ability. Study abroad may be approved in some cases. The annual stipends are $2,500–$5,000, and an annual allowance of $500 is provided to the institution to which each Fellow is assigned. Fields of study will be in chemistry and biology, including the preclinical medical sciences. Initial appointments will be for a term of one year, renewable for a second year, and, in exceptional cases, for a third year. Further information may be obtained from the National Research Council Fellowship Office, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Deaths

Sister Mary Rose (Murray), professor of chemistry, College of St. Elizabeth, Convent Station, New Jersey, died of a heart attack on June 11.

Sister M. Augustina (Brobston), 81, chairman, Department of Chemistry, College of St. Elizabeth, Convent Station, New Jersey, died suddenly July 21. She had been associated with the Department since 1906.

Mary Jones Fisher, at one time associate editor of *Biological Abstracts*, and more recently affiliated with the Academy of Natural Sciences in Philadelphia, died on October 9 in Dover, Delaware.

Frederic Ewald Sondern, 80, retired clinical pathologist and formerly president, New York State Medical Society, died October 10 at Post-Graduate Hospital, New York City, after a 6-week illness.

Robert H. Lombard, 59, who for the past 20 years had been research chemist in the Norton Company Research Laboratories, Worcester, Massachusetts, where he made important contributions to the abrasive industry, died on October 11.

Frank R. Lillie, 77, Andrew MacLeish distinguished service professor of embryology emeritus, and for over 20 years chairman, Department of Zoology, University of Chicago, died November 5 in Chicago.

With the hungry of Europe looking to America for food, clothing, and dollars to help them through the coming winter, we are again reminded of a way in which we as individuals can supplement the meager rations of these people. CARE (Cooperative for American Remittances to Europe, Inc.) food packages, each containing enough food to feed supplementary meals to a family of four for a full month, in addition to baby food, blanket, cotton, woolen, knitting wool, household linen, and layette packages, may be ordered for $10 each and will be dispatched promptly to a needy European friend. The offices of CARE are located at 50 Broad Street, New York City 4.

The Federation of American Scientists has made provision for admission of members-at-large. The chairman of the Federation, **Robert E. Marshak,** in announcing the provision, has written as follows:

"The Federation of American Scientists was formed to integrate those groups of scientists which sprang up spontaneously at the end of the war to alert the public to the implications of the development of atomic energy and to work for sound legislation and policy in this field.

"Some of the major activities of the Federation have been (1) providing accurate technical information to the public and to its leaders in order to establish a basis for intelligent social action; (2) mobilizing support for civilian control of atomic energy in this country; (3) supporting the confirmation of the present members of the Atomic Energy Commission; and (4) working for a National Science Foundation. In items (2) and (3) the Federation has been particularly effective.

"Scientists have played a prominent part in national affairs in the past two years, and they must continue to fulfill their responsibilities in the future. A few of the subjects under consideration by the membership are the need for more information on the factors involved in biological warfare; the re-establishment of the international scientific community by interchange of scholars, students, and technical information; and the general problem of secrecy in science. What part the Federation will play will be determined by its members. Important policy matters are carefully checked with the membership and decisions must be approved by a large majority.

"It is recognized that the active participation of many scientists is necessary if the Federation is to be representative and effective. At present there are 2,500 members, most of whom belong to the 19 local associations. The Federation is anxious to enlarge its membership, especially in the smaller scientific communities and places where groups have not yet been formed.

"Those who have the equivalent of a Bachelor's degree in the natural sciences, mathematics, or engineering are qualified to become members-at-large, and anyone who is interested in furthering the aims of the Federation is eligible for associate membership-at-large. Dues for members-at-large are set at $5.00 per year; for sustaining members, $10.00; and for patrons, $25.00 or over.

"Inquiries are cordially invited. They should be sent to the Federation of American Scientists, 1749 L Street, N. W., Washington 6, D. C."

The Scientific American, 102-year-old monthly magazine, has been purchased by The Sciences, Inc., which plans to convert it into a new magazine of the sciences to be edited and published by **Gerard Piel** and with **Dennis Flanagan** as managing editor. It will cover the physical, biological, and social sciences, engineering, and medicine, and will occupy a place between technical and professional journals and those reporting science in popular terms. The first issue of the new magazine will appear early in 1948, its price remaining at 50¢ per copy and $5.00 per year.

Erratum: In "Effect of Rutin on Anaphylactic and Histamine Shock" by R. J. Raiman, E. R. Later, and H. Necheles (*Science*, October 17, p. 368), the first sentence of the last paragraph should read as follows: "Another explanation for the protective effect of rutin may be that it prevents the liberation of endogenous histamine, perhaps by unknown factors other than those which decrease capillary permeability."

Make Plans for—

The American Philosophical Society, autumn general meeting, November 20–21, Philadelphia.

Tennessee Academy of Science, 57th annual meeting, November 28–29, University of Tennessee, Knoxville.

American Physical Society, November 28–29, Houston, Texas.

American Society of Animal Production, November 28–29, Chicago, Illinois.

The National Joint Committee on Fertilizer Application, annual meeting, December 15, Hotel Stevens, Chicago.

The Society of American Foresters, annual meeting, December 18–20, Minneapolis, Minnesota.

The Nature of the Iron Compounds in Red and Yellow Sandstone[1]

L. J. E. Hofer and Sol Weller

Central Experiment Station, Bureau of Mines, Pittsburgh, Pennsylvania

The color of sandstone usually is due to some form of iron which was probably deposited in the sandbeds from chalybeate water—for example, an aqueous solution of ferrous bicarbonate. Rayleigh (*3*) has demonstrated geologically probable conditions by which both red and yellow pigments can be formed from chalybeate water. Using these conditions, he has prepared both synthetic red and synthetic yellow sandstones. Both the red and the yellow pigments were demonstrated to be iron oxides or oxide hydrates with variable amounts of water. Rayleigh did not consider the difference in water content between the red and the yellow to be significant so far as color is concerned. The present paper deals with the identity of these pigments.

Rayleigh observed that chalybeate water standing undisturbed, exposed to the air, will simultaneously form both the red and the yellow oxide; the former develops as a skin upon the surface, whereas the latter forms a precipitate in the body of the solution. Formation of the red oxide is favored by increasing the area of air-solution interface; formation of the yellow oxide, by bringing more air into solution in the chalybeate water. By exposing sand moistened with chalybeate to air at 50°C., a red synthetic sandstone was obtained; but by exposing sand submerged in chalybeate water to air at the same temperature, a yellow synthetic sandstone was formed.

The oxidation of ferrous bicarbonate solutions has been studied previously by Albrecht (*1*), Schikorr (*4*), and Baudisch and Albrecht (*2*), all of whom agree that when undisturbed ferrous bicarbonate solutions oxidize, a crust of brown material forms on the surface while a yellow precipitate deposits in the bulk of the solution. The similarity in the manner of formation indicates beyond doubt that the brown and yellow oxides of these authors are identical or closely related to the red and yellow oxides of Rayleigh. X-ray diffraction patterns showed the brown oxide to be $\gamma Fe_2O_3 \cdot H_2O$ (lepidocrocite) and the yellow oxide to be $\alpha Fe_2O_3 \cdot H_2O$ (goethite). Normally both $\gamma Fe_2O_3 \cdot H_2O$ and $\alpha Fe_2O_3 \cdot H_2O$ are yellow (*5*); but $\gamma Fe_2O_3 \cdot H_2O$ is quite unstable, decomposing to γFe_2O_3 (maghemite-red) even at 100°C. The γFe_2O_3 so formed is itself metastable and can decompose to αFe_2O_3 (hematite-red). The color of the brown or red oxide observed by these authors is thus probably due to partial decomposition of $\gamma Fe_2O_3 \cdot H_2O$. The oxidation of ferrous bicarbonate solutions containing low concentrations of CO_2 favors the formation of $\gamma Fe_2O_3 \cdot H_2O$ in bulk rather than $\alpha Fe_2O_3 \cdot H_2O$ (*3*). This may explain why γ- rather than $\alpha Fe_2O_3 \cdot H_2O$ forms in the surface of oxidizing chalybeate water.

To check and extend these conclusions about Rayleigh's oxides, samples of both the red and the yellow oxides were made up according to his directions and studied by X-ray diffraction and the magnetic balance. Chalybeate water was prepared by bubbling CO_2 through distilled water in contact with high-purity iron shavings. The solution as used contained 0.655 gram Fe_2O_3/l. The yellow oxide was prepared by simply bubbling air through the solution and filtering and drying the precipitate. The red oxide was made by dropping the chalybeate water on a slowly rotating glass cylinder, which was dried by a hot plate. The temperature of the cylinder was kept well below 100°C. The red deposit so formed was scraped from the cylinder and used without further treatment.

X-ray diffraction patterns of the yellow oxide proved it to be mainly $\alpha Fe_2O_3 \cdot H_2O$. The magnetic susceptibility was 83×10^{-6} c.g.s. units/gram—in fair agreement with that of $\alpha Fe_2O_3 \cdot H_2O$ and $\gamma Fe_2O_3 \cdot H_2O$, both of which have susceptibilities of 42×10^{-6}. On heating the sample to 200°C. for about two hours, the susceptibility rose to $1,200 \times 10^{-6}$, indicating the presence of some $\gamma Fe_2O_3 \cdot H_2O$, which decomposes to ferromagnetic γFe_2O_3. X-ray diffraction patterns of the red oxide showed the presence of hematite and small amounts of γFe_2O_3. The magnetic susceptibility was $2,200 \times 10^{-6}$ as compared with 22×10^{-6} for hematite. The magnetism, readily demonstrated with a small permanent magnet, is undoubtedly due to γFe_2O_3.

Through the courtesy of David M. Seaman, of the Carnegie Institute, a series of sandstones were obtained for study. A specimen of red St. Peter's sandstone from Mineral Point, Wisconsin, contained 0.32 per cent iron as Fe_2O_3 and had a gross magnetic susceptibility of about 5×10^{-6}. The sand itself is almost pure quartz, as is shown by the fact that extraction with warm 1:1 HCl leaves a white product whose diamagnetic susceptibility ($X = -0.43 \times 10^{-6}$) is nearly the same as that of pure quartz ($X = -0.49 \times 10^{-6}$). The iron oxide in the sample thus must have a susceptibility of $1,600 \times 10^{-6}$. Such a high susceptibility could have originated only with γFe_2O_3. Since γFe_2O_3 is metastable with respect to αFe_2O_3 (paramagnetic, $X = 22 \times 10^{-6}$), this high susceptibility should be lowered on heating to 500°C. This was found to be the case; the gross susceptibility for the heated sandstone was only 0.76×10^{-6}, corresponding to an oxide susceptibility of 230×10^{-6}. Of the several other sandstones examined, all had susceptibilities far greater than could be attributed to hematite, goethite, or lepidocrocite; but unfortunately, the sandstones, after acid extraction, still had appreciable paramagnetic susceptibilities, and the results could not be so clearly interpreted as in the case of St. Peter's sandstone. The susceptibilities were measured in a field strength of 2,500 gauss.

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[1] Published by permission of the director, Bureau of Mines, U. S. Department of the Interior.

Cytochrome Oxidase[1]

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Separation and purification of the components of the cytochrome oxidase complex have literally presented an insoluble problem due to the difficulties experienced in attempting to dissolve the complex. Among the many attempts to obtain a solution of the enzyme has been that of Yamagutchi, Hiroshi and Ogura (*8*), who claimed a preparation from yeast and heart muscle that was active after filtration through a Seitz filter. Keilin (*5*) repeated the work and concluded that the enzymes were not in solution. Hogness, Altschul, and Abrams (*3*) reported a soluble preparation from yeast, but not all yeasts could be used, and the oxidase from any one source was not constant. More recently, Haas (*1*) has attempted to prepare a soluble oxidase from yeast by subjecting an insoluble complex to ultrasonic radiation. He succeeded only in reducing the size of the particle. Later he prepared a soluble component which is probably cytochrome A by incubating undiluted oxidase in boiling water for 3 minutes (*2*).

A report by Hopkins, Lutwak-Mann, and Morgan (*4*) on the use of bile salts in the preparation of succinic dehydrogenase suggested to us the use of sodium desoxycholate to dissolve the oxidase complex. By this method we have obtained a preparation which, when tested with the hydroquinone-cytochrome C system at pH 7.4, is 2.5 times as active as the Keilin and Hartree oxidase preparation. It retains its activity after centrifugation for 2 hours at 18,000 × g or after having been passed through a Seitz filter. Both preparations are clear and red-brown in color. A partial purification has been achieved by fractionating with sodium desoxycholate. The fractionated preparation is 4–6 times as active as the original Keilin and Hartree oxidase from which it is made.

TABLE 1

Sample	Total protein (mg./0.25 ml.)	15-minute oxygen consumption (mm.^{3}/0.25 ml.)	QO_2 protein
Keilin and Hartree oxidase......	0.202	27	400
Buffer control...................		7	
4 per cent desoxycholate extract..	0.200	60	1,040
2–4 per cent desoxycholate fraction	0.029	26	2,480
Desoxycholate control...........		8	

All extracts and fractionations with desoxycholate were made on a Keilin and Hartree (*7*) oxidase (fresh lamb heart) that had been diluted 1:1 with 0.1 M Na_2HPO_4-KH_2PO_4 buffer of pH 7.4. Cytochrome C was made by the method of Keilin and Hartree (*6*), and the hydroquinone-cytochrome C test system was similar to the one used by Haas except that buffer of pH 7.4 was used instead of pH 7.1.

Table 1 summarizes the results of our first experiments. All of the enzyme preparations were diluted 1:25 with distilled water as soon as possible after having been obtained in final form. The control for the Keilin and Hartree oxidase consisted of 0.25 ml. of 0.1 M Na_2HPO_4-KH_2PO_4 buffer of pH 7.4, that for the two desoxycholate preparations of 0.25 ml., 2 per cent sodium desoxycholate. The 4 per cent desoxycholate extract was made by adding 80 mg. of desoxycholate to 2 ml. of the Keilin and Hartree oxidase, grinding in a cold mortar at 4° for 10 minutes, and centrifuging at 18,000 × g for 1 hour. The 2–4 per cent desoxycholate fraction was prepared by adding 40 mg. of desoxycholate to 2 ml. of the Keilin and Hartree oxidase, grinding and centrifuging as above, and then adding to the precipitate 2 ml. of 4 per cent desoxycholate made up in 0.1 M Na_2HPO_4-KH_2PO_4 buffer of pH 7.4. Following a grinding in a cold mortar for 5 minutes at 4°, the suspension was centrifuged for 1 hour at 18,000 × g and the supernatant tested immediately after being diluted.

The effect of 2 inhibitors on the activity of the desoxycholate–Keilin and Hartree oxidase is shown in Table 2. The enzyme preparation was made by adding 3 per cent of desoxycholate to a Keilin and Hartree oxidase, grinding in the cold for 10 minutes, and centrifuging for 1 hour at 20,000 × g. The complete inhibition by 1×10^{-3} M NaCN and NaN_3 suggests that one of the enzymes involved is probably cytochrome oxidase.

These sodium desoxycholate preparations were unable to mediate the oxidation of d-glucose by d-glucose dehydrogenase of mammalian liver, even though the diphosphopyridine nucleotide and cytochrome C were added. This observation agrees with the work of Hopkins, Lutwak-Mann, and Morgan (*4*), who were unable to catalyze the oxidation of succinate with their preparation. These reactions will be studied spectrophotometrically in the immediate future. For the present it appears that cytochrome oxidase should be a constituent of these sodium desoxycholate–Keilin and Hartree oxidase preparations. This conclusion is based on the inhibitory action of NaCN and NaN_3 and on the fact that the oxygen consumption is reduced by about 95 per cent in the absence of cytochrome C.

TABLE 2

Sample	Final concentration of inhibitor	15-minute oxygen consumption (mm.^{3}/0.25 ml.)	QO_2 protein
3 per cent desoxycholate extract*		40	1,030
	1×10^{-3} M NaCN	2	0
	1×10^{-3} M NaN_3	6	0
Desoxycholate control		6	

* Total protein = 0.140 mg./0.25 ml. at 1:25 dilution.

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Differential Rate of Death for Large and Small Fishes Caused by Hard Cold Waves

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In 1930 Hildebrand and Cable (*3*) noted some indication that young marine fishes survived sudden cold spells better than larger ones. Gunter (*2*) in 1938 independently made observations indicating that young poikilothermal marine animals survived cold spells better than their elders. The question was raised again in 1941 by Gunter (*2*) in a discussion of the mortality caused on the Texas Coast by the hard cold wave of 1940.

Baughman (*1*), in a recent popular account of the damage done by the January 1947 freeze on the Texas Coast, noted the peculiar absence of small redfish, *Sciaenops ocellata* (Linnaeus), among fishes killed by the freeze, although their larger congeners were quite abundant.

TABLE 1

Numbers, Sizes, and Means of Two Species of Fishes Taken Following the Cold Spell of January 1, 1942, in Copano Bay, Texas

Species	Condition	No.	Length range (mm.)	Arithmetic mean	Median	Mode
Anchoa mitchilli diaphana	Alive	150	22–76	37.2	34.8	34.8
	Dead	38	27–68	41.2	40.5	44.3
Menidia beryllina peninsulae	Alive	127	22–74	40.0	36.3	31.2
	Dead	10	38–55	46.6	46.8	45.5
Both species combined	Alive	277	22–76	38.9	35.6	30.8
	Dead	48	27–68	42.3	43.0	44.7

On January 1, 1942, a light cold wave struck the Texas Coast. The occurrence was described by Gunter in 1945 (*2*). Since regular observations were being made at set stations at that time, it was hoped that any differential mortality occurring between young and older fishes would be detected. However, the cold spell was light and few fishes were killed. Only in Copano Bay, where two small fishes, the bay anchovy, *Anchoa mitchilli diaphana* Hildebrand, and the Gulf silverside, *Menidia beryllina peninsulae* (Goode and Bean), were killed in small quantities, were all conditions proper for comparison. Total length frequency curves for each species were drawn, and although "they might appear to be slightly indicative of a differential effect of cold on the smaller and larger fish," due to the small numbers of the sample and the slight differences shown they were not accepted as proof and were not presented. However, since the size ranges of the two species corresponded very closely, it has been decided that there is no logical reason why the two samples should not be combined to give better exposition of the data.

The conditions under which the two fishes were caught were stated in some detail by the writer in 1945 (*2*) and will not be repeated. All fishes were measured in millimeters. Although 392 anchovies were taken, only 150 were measured. All dead anchovies and all silversides taken were measured. The numbers of specimens of each species, alive and dead, the length ranges, and means for all groups, separate and combined, are given in Table 1. Application to these data of Fisher's method (*Statistical methods for research workers*, 10th ed., p. 96) for the treatment of 2 x 2 tables was made by Frank W. Weymouth, to whom the writer is much indebted. If the distributions are divided into "large" and "small" at the size giving no "small" dead fish, the 2 x 2 tables given in Table 2 are derived. The chances of getting the numbers in the cells with the observed marginal totals are 4 and 5 in 10,000, a highly significant difference in mortality for large and small fish.

These data are taken as indicative of the fact that under natural conditions the larger specimens of certain species of fishes are killed by cold waves in proportionately greater numbers than the smaller specimens. The observations bear out unchecked general observations previously made by the writer and others and cited above.

Much more extensive observations on this subject should be made both in the field and in the laboratory. Pearse and Wharton (*4*), in connection with their life-history study of the marine turbellarian, *Stylochus inimicus* Palombi, found that young worms survived induced cold better than larger specimens. This is the only experimental work on the subject with which the writer is acquainted.

TABLE 2*

	Anchoa mitchilli diaphana		
	Small (26 mm. and less)	Large (27 mm. and more)	
Alive	31	119	150
Dead	0	38	38
	31	157	188
p = .0045			

	Menidia beryllina peninsulae		
	Small (37 mm. and less)	Large (38 mm. and more)	
Alive	70	57	127
Dead	0	10	10
	70	67	137
p = .0054			

* Dividing the distributions into "large" and "small," at the length below which there are no small dead fish, gives the 2 x 2 tables, showing a significant difference in mortality of large and small fish. See text for full explanation.

Reasons for a possible differential mortality of young and old poikilothermal animals are completely unknown, and any discussion of the point would be pure conjecture. However, this subject raises many interesting questions concerning comparative and general physiology, especially as they are concerned with the phenomena of aging.

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Hemophilia: The Mechanism of Development and Action of an Anticoagulant Found in Two Cases[1]

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In this preliminary report the nature of an anticoagulant found in the circulating blood of two hemophiliacs is presented. One of these patients (W. P.) was previously reported by Lawrence and Johnson (*1*). A second case was studied by Munro and Jones (*4*), who felt that the anticoagulant appeared as a result of repeated transfusions. Later analysis of the blood of this patient (*3, 5*) revealed the anticoagulant to be associated with the gamma globulin fraction of blood.

TABLE 1

Demonstration of Anticoagulant Effect of Blood of Patients W. P. and D. M. on Normal Blood

Tube No.	1	2	3	4	5	6	7	8	9	10
Patient's blood (cc.)	0.0	0.0	0.0	0.4	0.8	1.2	1.6	2.0	2.0	2.0
Normal blood (cc.)	2.0	2.0	2.0	1.6	1.2	0.8	0.4	0.0	0.0	0.0
Clotting time (min.) Patient Date										
*W. P 9/ 9/46	8	8	8	7	8	8	8	70	71	68
W. P. 4/24/47	6	6	7	8	10	16	36	60	52	60
W. P. 4/29/47	7	7	6	10	12	18	40	58	56	58
D. M. 4/22/47	8	6	6	14	15	16	17	75	73	75
D. M. 4/23/47	6	6	6	9	14	15	16	100	98	95

* This test was performed 8 months after the last transfusion.

The two cases included in this report are typical, proven hemophiliacs, each having had the disease since childhood. It had been observed that, at various periods when hemorrhage was severe, each would become refractory to treatment, continuing to bleed with elevated coagulation times in spite of repeated transfusions. At such a time an anticoagulant was found in the circulating blood of W. P. by Lawrence and Johnson (*1*). However, in the interim between hemorrhagic episodes both patients were relatively asymptomatic. During such a period W. P. was tested for the presence of an anticoagulant, and none was found.

At the time of admission to this hospital, both patients were bleeding severely, W. P. from the gastrointestinal tract and D. M. from the genitourinary tract. Each was immediately given whole fresh blood, unfortunately before an anticoagulant test was performed. However, the coagulation times were followed at ½-hour intervals. W. P. was found to show no response at all, either symptomatically or as measured by the coagulation time. D. M. responded transiently to the first transfusion, the coagulation time falling from 60 to 15 minutes, but rising again over a 3-hour period. Subsequent transfusions resulted in no improvement either clinically or by laboratory findings. In fact, in the case of D. M. it was noted that, after two transfusions of whole fresh blood and two injections of one vial each of antihemophilic globulin (Fraction I of Cohn–Squibb), the coagulation time had risen from an average of 60 minutes to 120 minutes.

Following these observations, both patients were tested for the presence of a circulating anticoagulant as follows:

After first injecting 5 cc. of saline, 10 cc. of blood were removed at exactly the same moment and rate from the patient and a normal subject, respectively. The two samples were then mixed in varying amounts in clean, graduated, 15-cc. centrifuge tubes which had been rinsed with saline. The results (Table 1) were found repeatedly and indicated definitely the presence of a circulating anticoagulant which had the ability to prolong the coagulation time of normal blood. Control tests performed with the blood of two ordinary hemophiliacs gave negative results, the clotting time being normal in all tubes in which any normal blood was present. The anticoagulant could also be demonstrated by mixing plasma from the patients with normal plasma in varying amounts.

An attempt was then made to determine which phase of coagulation was inhibited by this anticoagulant. The prothrombin concentration and conversion rate were normal for both patients, thus eliminating the presence of anti-prothrombin. Antithromboplastin, as described by Tocantins (*7*), was not present because, even though the blood was handled in such a way as to destroy the antithromboplastin which he described, the anticoagulant effect was still present. Also, tests using thromboplastin serially diluted to the point where its action on normal plasma was delayed failed to show any greater delay in prothrombin conversion when the plasma of either patient was used. Antithrombic activity was not found to be present since, when a known amount of thrombin (2 units) was added to the plasma of the patients (0.1 cc.), clotting occurred in the normal time. Antifibrinogen was not present since the final fibrin clot which formed in these cases was normal in its volume, retraction, elasticity, and strength. Therefore, it was evident that the anticoagulant was not antagonistic to any one of the components of the classical theory of coagulation.

Electrophoretic fractionation of the plasma of W. P. was performed by Eric Alling. Of the four fractions separated in this manner, one (fraction #1) contained only gamma globulin, and another (fraction #4) contained all components except gamma globulin. Each of these fractions was then tested for its anticoagulant activity. It was found that all fractions except fraction #4 inhibited the coagulation of normal plasma. Therefore, the anticoagulant was associated with gamma globulin. This finding is similar to that of Munro (*5*).

Since the anticoagulant was a gamma globulin and since it appeared only after repeated transfusions of whole blood or injections of antihemophilic globulin, it was thought conceivable that the anticoagulant might be the result of an "immunization" of the patient with some substance present in normal blood or Fraction I of Cohn but lacking in the patient's blood. Consequently, precipitin tests were performed using the sera of the two patients against serial dilutions of Fraction I of Cohn, containing a known amount of protein and adjusted to a pH of 7.0. There were positive precipitins in the sera of both patients, W. P. being positive at 1/320 and D. M. at 1/160. Control tests using normal sera, sera from nonhemophilic patients who had received frequent trans-

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[1] This document is based on work performed under Contract No. W-7401-eng-49 for the Atomic Energy Project at the University of Rochester.

fusions, and sera of ordinary hemophiliacs were negative. Control antigens of purified gamma globulin, human fibrinogen, and albumin gave negative results. These titers were obtained repeatedly, no change being noted throughout the hospital stay, in spite of repeated transfusions.

The anticoagulant was then shown to inhibit directly antihemophilic globulin. Taylor, *et al.* (*6*) have shown the *in vitro* effect of antihemophilic globulin in lowering the clotting time of hemophiliac patients. This could be repeated by us in the case of ordinary hemophiliacs who responded to blood or plasma in the usual fashion. However, in the two patients presented no effect was noted. Also, if the antihemophilic globulin was first incubated with the proper amount of serum from each of these patients, its acceleratory action on the clotting time of ordinary hemophilic blood was lost. If the globulin was incubated with the same amount of normal or ordinary hemophilic serum, the activity of the globulin when added to the blood of an ordinary hemophiliac was unimpaired.

It was evident from these results that the antihemophilic globulin, which alone had such a marked acceleratory effect on ordinary hemophiliac blood, was in some way tied up by the sera of these two patients. In view of the demonstration of definite precipitins in their sera it was felt that the sera probably inhibited or tied up the antihemophilic globulin by means of an antigen-antibody reaction.

On the basis of the evidence presented the following hypothesis was formed to explain the presence of the anticoagulant in these two patients. Each was deficient in, or lacked, the substance known as antihemophilic globulin in his blood—a substance shown to be essential for the coagulation of blood in the normal time. Just where this globulin enters into the coagulation mechanism is unknown, but it would seem that it is necessary for liberation of thromboplastin from platelets in the first stage of clotting. When this globulin is given intravenously to ordinary hemophiliacs, either in the form of fresh blood or plasma or antihemophilic globulin contained in Fraction I of Cohn, it causes a marked acceleration of coagulation (*2*). In these two cases repeated injections of this globulin are thought to have resulted in the formation of antibodies against this globulin. These antibodies, of course, have the ability to inhibit any globulin which is later given. Therefore, these patients became refractory to further transfusion or injection of Fraction I. No beneficial effect resulted from further injections since the active globulin factor which was being given, and which is necessary for normal coagulation, was immediately rendered ineffective by the circulating antibodies. Likewise, the circulating antibodies would exert an anticoagulant effect when the patients' blood was mixed with normal blood *in vitro* by inhibiting the globulin substance present in normal blood.

The explanation proposed for the development of a refractory state to transfusion in these two hemophiliacs, based upon an immunologic response to injections of a globulin fraction deficient or lacking in their blood, may also be the underlying factor in the refractory phase manifested by many hemophiliacs. The appearance of specific antibodies which inhibit antihemophilic globulin, and thus delay the coagulation of normal blood, may depend upon several factors which are not yet clear. Whether or not a complete absence of this globulin from the blood of the hemophiliac receiving transfusions or injections of the globulin is mandatory for the development of these antibodies is not known. Perhaps there are varying degrees of hemophilia accompanied by varying degrees of deficiency of this globulin and varying ability to respond to injections of the globulin. In some of those who have a marked lack, or perhaps a complete absence, of the globulin in their blood the response would be "isoimmunization" with the development of antibodies against the injected globulin. These cases would show a refractory state to further injections of globulin, and their blood would demonstrate anticoagulant activity when added to normal blood.

Further investigation is to be carried on to determine if a mechanism such as that described is more generally applicable to hemophiliacs who become refractory to treatment.

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A Homogeneous Emulsion of Fat, Protein, and Glucose for Intravenous Administration

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Several investigators (*3*) have reported success in the preparation of various types of fat emulsions, some of which were well tolerated on intravenous injection into animals. Also, experimental evidence has been produced to show that such fat administered intravenously was properly metabolized for energy utilization (*2*) and was not lost in either urine or feces. Intravenous studies of emulsions combining the three primary foodstuffs were attempted only once (*1*), and, had this procedure been routinely practical, it would have constituted another advance in surgical parenteral nutrition.

Egg lecithin, soybean phosphatides, and other chemical agents have been used as stabilizers in the emulsification and homogenization of fat. Such emulsions, although well tolerated in some cases, have not been uniformly dependable for intravenous injection because of varying degrees of toxicity believed to be due to the chemical complexity of the stabilizing agent. Hydrophilic colloids, both acid and alkaline, were used in the stabilization of fat but on biological investigation were discarded because of the frequency of fatal embolism after injection of emulsions prepared in such manner.

In this laboratory two satisfactory types of fat emulsion have been prepared. The first type was an emulsion of coconut oil and serum albumin which, on homogenization, yielded a highly stabile preparation well tolerated intravenously. The

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[1] The cooperation of Profs. Mulholland and Co Tui is gratefully acknowledged.

second type, derived from glucose, protein, and fat, was prepared in the manner described below from solutions which are commercially available in sterile containers and from a neutral saturated coconut oil which can easily be sterilized with safety. The following represents the basic proportions of the ingredients which are mixed in a 5-gallon, sterile flask: 1 l. of 6 per cent infusion gelatin (Knox P-20), 1 l. of protein hydrolysate 5 per cent amino acid solution, 200 cc. of 50 per cent glucose solution, and 100 grams of pure, refined, edible coconut oil.

After thorough mechanical agitation, the mixture is put through the Logeman homogenizer, an instrument so constructed as to make possible sterilization of its working parts. After this procedure of emulsification and homogenization, the material is collected in sterile vacuum bottle dispensers without any other processing and stored in the refrigerator. Refrigeration converts the emulsion into a solid gel which can be restored to the liquid state by warming the dispensing flask in hot water. Refrigerated samples have maintained complete stability after two months storage. Test samples of the pH of the emulsion averaged 6.5. The droplets were smaller in size than that of the canine erythrocyte and were comparable to that of the chylomicra. The concentrations of fat protein and glucose were approximately 5 per cent each and averaged 800 cal./l. The gelatin acted as a stabilizer, partially as a source of nutrient energy, and served to maintain colloid osmotic pressure.

This emulsion was administered intravenously to 7 dogs and 12 hospital patients. In the latter group at hourly intervals for a period of 8 hours during and after the infusion, temperatures, blood pressure readings, and blood samples were taken. In both groups there occurred no serious untoward reactions as were indicated by the latter studies. Two of the animals received 150 cc. of this emulsion (approximately 7.5 grams of fat) daily for 35 days. The others were sacrificed at varying times for evidence of fatty degenerative changes in the liver, lung, brain, and other organs. Microscopic examination of osmic acid, Sudan III, and hematoxylin eosin preparations failed to show evidence of lipoid granulomatosis. Three patients were maintained exclusively on this emulsion during the postoperative period with satisfactory results. One malnourished patient received with benefit a total of 5,500 cc. of the emulsion (approximately 200 grams of fat) intravenously for a period of 8 days. The emulsion caused no thrombosclerotic changes in the recipient vein and was nonirritating when infiltrated into tissue. Vitamin B and methyl donators were supplied to ensure utilization of fat. Penicillin could be added to the emulsion for intravenous administration.

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IN THE LABORATORY

The Importance of Controlling Cooling Temperatures During Embedding in Paraffin

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Many textbooks of microtechnique (*1*) urge the use of only enough paraffin to cover the specimens and the use of cold water for solidifying paraffin in the process of embedding. Johansen recommends using ice water when embedding during hot weather. Unfortunately, our laboratory has found that this is not always sound advice. The use of cold water for solidifying our particular embedding mass had always resulted in cavitation or numerous low-density areas. Usually the cavities were quite large and were located in the central portion of the block, separated from, or adjacent to, the embedded materials. In an attempt to rectify the situation a series of experiments were carried out. In the light of Johansen's recommendation to use ice water for cooling, it should be stated that the experiments were conducted during the month of August, when temperatures in the room where embedding was done were 90–95° C.

In the first experiment an embedding mass[1] with a boiling point of 54–56° C., heated to 56° C., was poured into paper "boats" 2½ inches long and ¾ inch wide. No specimens were embedded. Some of the "boats" were filled (¾ inch thick), others were poured medium full (½ inch thick), and only a thin layer (¼ inch thick) was poured into others. The paraffin in three such sets was solidified in water at 9° C., 22° C., and 34° C., respectively. In each case the surface of the paraffin was blown upon, and as soon as a supporting crust was formed, the boat was submerged for 12 hours. At the end of the 12-hour period, the boats were dried and the paraffin blocks removed.

Upon cutting the blocks it was found that those medium full and full which had been cooled at 9° C. had large (3 mm. in diameter) continuous or discontinuous cavities throughout the central portion. Both top and bottom surfaces were decidedly concave. The corresponding blocks cooled at 22° C. and 34° C were solid and of desirable texture throughout. The top surface of both sets was concave. The bottom surface of those cooled at 34° C. was either level or slightly convex; that of those cooled at 22° C. was concave but not as deeply so as in the case of those cooled at 9° C. The shallowly poured block cooled at 9° C. was solid and of good texture throughout. The shallowly poured blocks cooled at 22° C. and 34° C. were somewhat frothy with small cavities (less than 1 mm. in diameter) throughout the central portion from top to bottom and to within 3 or 4 mm. of each side. The bottom of the shallowly poured block cooled at 9° C. was slightly concave, at 22° C. flat, and at 34° C. slightly convex.

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[1] A mixture of 360 grams of Parawax 40 grams of bayberry wax, and [illegible] grams of stock rubber paraffin (1 pound of Parawax, 10 grams of crude rubber, and ½ gram of asphaltum).

Solid pieces of paraffin shaped from comparable locations in blocks cooled at 9° C., 22° C., and 34° C. were sectioned at 5μ and 10μ. All pieces cut equally well and formed excellent ribbons. Pieces of each ribbon were placed on dry slides as well as on slides smeared with Haupt's adhesive and flooded with 3 per cent formalin water. The wet slides were placed on a warm plate, and after the ribbons had flattened and the water had evaporated, both sets of slides were examined microscopically at 125 and 537 magnifications. No consistent differences in texture, crystal size, or any other characteristic could be perceived or measured.

After establishing an optimum cooling temperature range (22–34° C.), large, medium, and small pieces of plant materials were embedded in boats poured full and medium full of paraffin. When these were cooled at various temperatures within the range, the same kinds of results were obtained as for the solid paraffin blocks.

It is improbable that all types of embedding masses have the same optimum cooling range. For this reason it would seem desirable, especially if unsatisfactory results have been obtained, to establish a range for cooling the particular embedding mass used. For practical purposes the complete optimum temperature range need not be determined. It may be found that very low temperatures resulting from icing the water will produce the best results in some cases. They certainly do not give acceptable results in all cases.

In order to determine the effect of disturbing the cooler bottom layer of paraffin soon after pouring, a boat was poured medium full of paraffin at 56° C., and the bulb of a glass thermometer heated to the same temperature was moved in and over the cooler layer of paraffin in a manner resembling rather rough orientation of materials. Care was taken not to introduce air into the paraffin by lifting and lowering the bulb of the thermometer above the surface. Before crystals began forming on the surface, the thermometer was removed, and the boat of paraffin was cooled within the optimum temperature range. The resulting block was solid but had scattered, minute, low-density areas throughout. This experiment was repeated using a "cold" (room temperature) dissecting needle. The resulting paraffin block contained small holes in the disturbed layer at the bottom of the block and numerous, low-density, pin-point spots throughout much of the block.

Our experiments have shown, therefore, that (*1*) for consistently good results, paper embedding boats should be well filled with paraffin to a depth of ½ inch or more; (*2*) an optimum cooling temperature range should be determined for each type of paraffin embedding mass used; (*3*) rapid cooling of some embedding masses does not appreciably improve the quality of the block to be sectioned; (*4*) the use of cold water for cooling may result in cavitation and low-density areas; (*5*) paraffin blocks with flat bottoms may be obtained by choosing the correct cooling temperature; and (*6*) material orientation maneuvers should be held to a minimum and be performed with instruments warmed to the temperature of the embedding mass.

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The Demonstration of Naturally-occurring Streptomycin-resistant Variants in the Human Strain of Tubercle Bacillus H-37RV[1]

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The development of resistance by tubercle bacilli to streptomycin is of considerable practical importance. To help elucidate this problem, an attempt was made to demonstrate the presence of naturally-occurring resistant variants in a stock laboratory strain of H-37RV by examining a large number of organisms. Variants highly resistant to streptomycin have been demonstrated in cultures of *Shigellae* (*5*), strains of *Staphylococcus aureus*, *Staph. albus*, *Proteus vulgaris*, and *Escherichia coli* (*4*), and *Hemophilus influenzae* (*1*).

TABLE 1

	Streptomycin (μg./cc.)				
	0.74	0.37	0.18	0.09	Control
Growth after 3 weeks	0 0	0 0	+++ +++	++++ ++++	++++ ++++

TABLE 2

	Tubes with growth			% showing growth		
	3 weeks	4 weeks	Total	3 weeks	4 weeks	Total
Series I, 100 tubes..............	3	5	8	3	5	8
Series II, 40 tubes..............	2	0	2	5	0	5

Cultures were made in the liquid medium described by Dubos (*3*), using 10-cc. rather than 5-cc. quantities. A single 4-week-old culture of the human laboratory strain H-37RV growing in Dubos medium was used as the source of the test organisms. The concentration of tubercle bacilli (mg./cc.) was determined by turbidimetric readings in calibrated tubes, using a blue filter (420 mμ) in a Lumetron colorimeter. Streptomycin assays on the supernatant fluid were done, using *Klebsiella pneumoniae* #41 as the test organism according to the method described by Alture-Werber and Loewe (*2*).

Series I: Each of 100 tubes of Dubos medium containing 18.5 μg. of streptomycin/cc. was inoculated with 0.1 mg. of the test culture of H-37RV.

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[1] Supported by a grant from the U. S. Public Health Service. We are indebted to William Steenken, of the Trudeau Laboratory, for the strain of H-37RV and to G. Rake, of the Squibb Institute for Medical Research, for the strain *Klebsiella pneumoniae* #41.

Series II: Each of 40 tubes containing 37 μg. of streptomycin/cc. was inoculated with 0.2 mg. of H-37. A routine streptomycin sensitivity assay was done on organisms from the same culture used to inoculate Series I and II with an inoculum of 0.1 mg. Tubes showing growth in Series I and II were centrifuged, the supernatant saved for streptomycin assay, and the bacilli resuspended in fresh Dubos medium. A turbidimetric reading was made and 0.1-mg. amounts were inoculated into tubes for a second streptomycin sensitivity assay.

The assay on H-37 done in duplicate gave 0.37 μg. of streptomycin/cc. as the amount necessary to inhibit growth completely (Table 1). These results agreed with previous testing of this particular strain done in this laboratory. It is apparent that the tubes in Series I contained 50 times the amount of streptomycin necessary to produce complete inhibition of growth, and those in Series II, 100 times the amount.

At the end of 3 weeks, 3 tubes in Series I and 2 tubes in Series II showed definite growth. At the end of 4 weeks, 5 additional tubes in Series I showed growth (see Table 2).

Streptomycin sensitivity assays were done on cultures which showed growth in Series I and II, and the results given in Fig. 1 are representative. The turbidimetric values plotted in the graphs are an average of readings of 4 tubes in each series. Note that the base line for tubes containing 3,700 μg./cc. is at 75. The high concentration of streptomycin gave a distinct yellow color to the medium and resulted in the high initial reading, since the blank tube used for all readings contained only Dubos medium.

Only a fraction of the tubes containing 50–100 times the amount of streptomycin capable of producing complete bacteriostasis on routine sensitivity assay showed growth. The bacilli which multiplied, however, showed a remarkable resistance to streptomycin, being capable of growing in 10,000 times the amount initially adequate to prevent growth. It can be seen in the graph that growth curves for tubes containing up to 1,000 times the amount of streptomycin usually inhibitory parallel the curve for the control tube. If anything, they show a more rapid growth than the controls. Tubes containing 3,700 μg. showed a flatter curve, but growth was quite distinct.

Assays done on the supernatant fluid showed 2 μg./cc. in Series I and 4 μg./cc. in Series II at the end of one month. The tubercle bacilli from these same cultures showed resistance to 3,700 μg./cc. in a subsequent sensitivity assay. Obviously, there had been a gradual loss of streptomycin activity, but even at the end of a month the amount of streptomycin present in Series II was more than 20 times that necessary to inhibit growth in the initial assay.

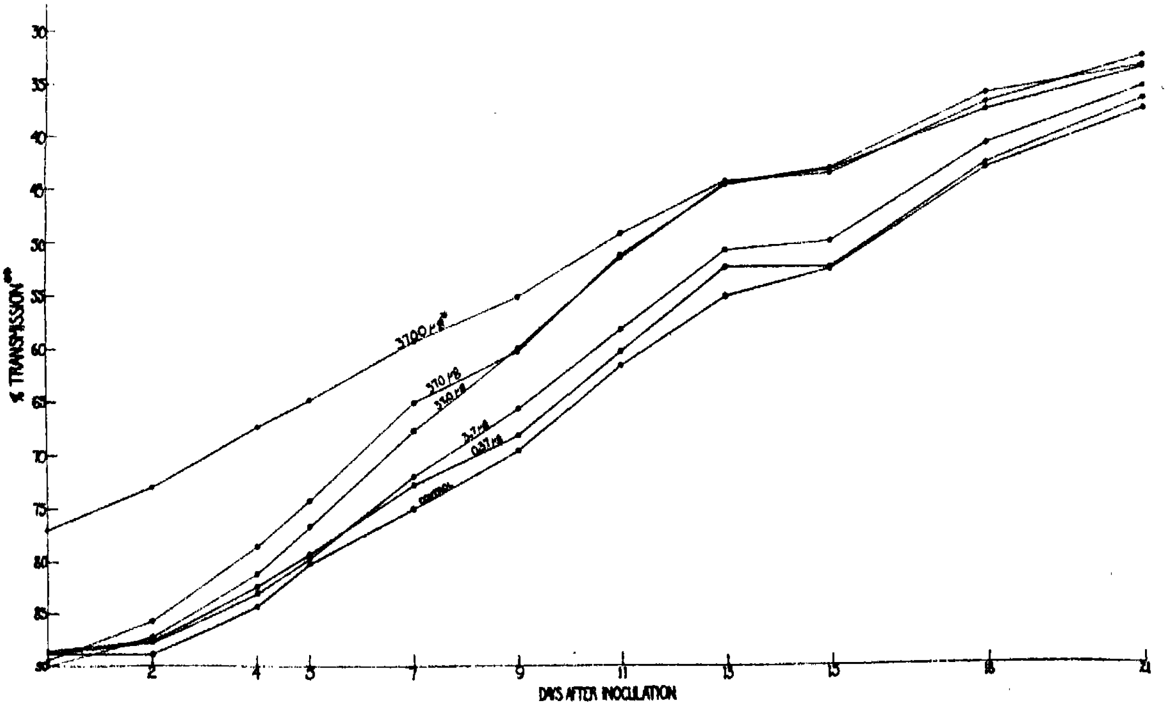

FIG. 1. Streptomycin sensitivity assay on resistant organisms from Series I: * micrograms of streptomycin/cc. of medium; ** % transmission using the blue filter (420 mμ) in a Lumetron colorimeter.

Thus, by using large numbers of bacilli it is possible to demonstrate the occurrence of streptomycin-resistant variants of tubercle bacilli in cultures not previously exposed to streptomycin. It is possible that these naturally resistant variants play a part in the development of streptomycin resistance *in vivo*.

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Book Reviews

A history of the American Medical Association, 1847–1947. Morris Fishbein. Philadelphia–London: W. B. Saunders, 1947. Pp. xvi + 1226. (Illustrated.) $10.00.

This revealing volume is not a critical analysis of the development of the most important medical organization in the United States, but rather a chronology of its activities during its first century of existence, as abstracted from its *Transactions*. Projected in 1929, the satisfactory compilation of the book was delayed by World War II. It was pushed to publication for the centennial meeting of the AMA in May 1947 by the driving efforts of Dr. Fishbein with hurried dictation, scissors, and paste. The result is sometimes reminiscent of the famous "Tonics and Sedatives" section of the *Journal of American Medical Association*, which Dr. Fishbein has edited so well since 1924. Dr. W. L. Bierring's accounts of the 101 presidents of the Association are customary professional eulogies. Various Association officials offer short sketches of the many councils, bureaus, publications, and other special activities of the Association. From these it is clear that, in contrast to its first 50 years, the second half-century of the AMA has been extremely successful in a practical and financial sense. There are chronological data in appendixes, and there are name and subject indexes.

The American Medical Association arose a century ago in response to serious abuses in medical education and practice. The rapid expansion of the country, with the resulting need for many doctors, caused a mushroom growth of medical schools and a large output of unsatisfactory and unqualified physicians. A number of abortive attempts were made to form a national organization of competent medical men, in order to raise standards of medical education and of medical ethics. Thanks to the persistence and skill of Nathan Smith Davis (1817–1904) of Binghampton, New York, this was accomplished. An organizational meeting was held in May 1846, in New York, and the first convention with delegates took place the following year in Philadelphia. The Association has consistently maintained a democratic organization through delegates elected by State Medical Societies. After a century of intensive effort, it is clear that the prime purpose of the AMA in raising standards of medical education has been brilliantly achieved. Unfortunately, there still remains much confusion about "medical ethics." However, the majority of physicians are agreed regarding their standards of professional etiquette and general morality, and this is an important advance. There is now growing appreciation that general principles of ethical conduct are more significant than a multiplicity of detailed rules.

An outstanding public contribution of the AMA has been the gradual suppression of medical quackery. This part of the story is told with relish, and with details of libel suits brought by various quacks as a result of published AMA reports. There is also much in justification of the AMA's stand on "socialized medicine."

The official centennial story of the Association is an interesting social document for scientists. It illustrates the difficulties and disappointments inherent in the development of large professional organizations, and suggests the wisdom of frequent, honest, and good-natured self-criticism in such organizations for the promotion of professional standards and practices.

Chauncey D. Leake

The University of Texas—Medical Branch, Galveston

Scientific Book Register

Boyd, William C. *Fundamentals of immunology.* (2nd ed.) New York-London: Interscience, 1947. Pp. xvi + 503. (Illustrated.) $6.00.

Brues, Charles T. *Insects & human welfare.* (Rev. ed.) Cambridge, Mass.: Harvard Univ. Press, 1947. Pp. xiii + 154. (Illustrated.) $2.50.

Copeland, Edwin Bingham. *Genera Filicum: the genera of ferns.* Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1947. Pp. xiv + 247. (Illustrated.) $6.00.

Dyk, Walter. *A Navaho autobiography.* (Publ. in Anthropology, No. 8.) New York: Viking Fund, 1947. Pp. 218. (Illustrated.) $3.00.

Eames, Arthur J., and MacDaniels, Laurence H. *An introduction to plant anatomy.* (2nd ed.) New York: McGraw-Hill, 1947. Pp. xvii + 427. (Illustrated.) $4.50.

Glaessner, Martin F. *Principles of micropalaeontology.* New York: John Wiley, 1947. Pp. xvi + 296. (Illustrated.) $6.00.

Jaggar, T. A. *Origin and development of craters.* (Geological Society of America, Memoir 21.) Baltimore, Md.: Waverly, 1947. Pp. xvii + 508. (Illustrated.) $6.00.

Josephy, E., and Radt, F. (Eds.) *Elsevier's encyclopaedia of organic chemistry.* (Vol. 13, *Tricyclic compounds*: Series III, *Carboisocyclic compounds.*) New York-Amsterdam: Elsevier, 1946. Pp. xx + 1265. Single vol., $104.00; serial price, $91.00; subscription price, $78.00.

Laskowitz, I. B. *Designs for helicopters.* Brooklyn, N. Y.: I. B. Laskowitz, 284 Eastern Parkway, 1947. Pp. 23. (Illustrated.) $2.00.

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Tomkins, Silvan S. *The thematic apperception test: the theory and technique of interpretation.* New York: Grune & Stratton, 1947. Pp. xi + 297. $5.00.

Witt, J. C. *Portland cement technology.* Brooklyn, N. Y.: Chemical Publishing Co., 1947. Pp. 518. $10.00.

Wolff, Werner. *What is psychology: a basic survey.* New York: Grune & Stratton, 1947. Pp. xii + 410. (Illustrated.) $4.00.

Fourth International Cancer Research Congress:

St. Louis, September 2–7, 1947

E. V. Cowdry, *President*[1]

PRESIDENT TRUMAN, IN HIS OPENING message to the Congress, said:

> This meeting has large significance to the United States and to the world at large from every point of view—social, economic, political, and spiritual. No further argument is needed to support such a statement than the fact that in the United States alone 180,000 persons die annually of cancer. The last war showed more clearly than ever before the value of coordinated research. How fruitful, therefore, will be this assembly from the whole world of scholars interested in the solution of the cancer problem.

In a later telegram the President advised the Congress as follows:

> It is now possible for the United States to take an important forward step toward greater international cooperation in the field of medical and biological research. On behalf of the people of the United States I am pleased to announce to the Fourth International Cancer Research Congress that progress in the production of radioisotopes by the United States Atomic Energy Commission now permits limited distribution to qualified research workers in other countries of radioisotopes principally for medical and biological research. I know that the representatives of the United States attending the cancer research congress share my hope that the open, impartial and truly international character of medical research will carry over into the realm of other problems of world concern. The sharing by and among all nations of both the means and the results of cancer research will reduce the loss of life and human suffering from disease throughout the world.

Thus, the Cancer Research Congress commenced very auspiciously. The suggestion by the President of the United States, that the members were pioneers in international cooperation and that success by them in the field of cancer research might lead the way to international teamwork in other matters, was stimulating. The announcement by him that henceforth all nations can share in the opportunities for investigation provided by radioactive isotopes was a long step in the right direction. Indeed, it answered a question uppermost in their minds.

The attendance from abroad was larger than we had dared expect at a time when travel was difficult and the whole world was busy trying to recover from the last war. The fact that this attendance amounted to 139 is due to help received from many sources.

The chairman of the Governmental Liaison Committee, L. A. Scheele, worked long, faithfully, and wisely in Washington. We have him to thank especially for the effective cooperation of the U. S. Department of State. Had it not been for the courtesy of the Department in transmitting invitations to all nations of the world, except Japan, Germany, and Spain, the attendance of official delegates from abroad would have been nil.

Early realization of the fact that, in addition to these official delegates, many other leaders in cancer research would like to attend the Congress, but could not because of financial obstacles, led to prompt action. S. Bayne-Jones, chairman of the Finance Committee, raised money not only for routine expenses of the Congress but also, in many instances, for travel. The most substantial donors were: the American Cancer Society and its agent, the Growth Committee of the National Research Council, the U. S. Public Health Service through the National Advisory Cancer Council, the Jane Coffin Childs Memorial Fund, Eli Lilly & Company, the Anna Fuller Fund, and Barnard Free Skin & Cancer Hospital.

The Danforth and Donner Foundations made no payments directly to the Congress but did financially assist representatives from abroad to attend. Mr. Edwin S. Jones of the First National in St. Louis, served as treasurer of the Congress.

Represented at the Congress were: Argentina, Australia, Belgium, Bolivia, Brazil, Canada, Chile, China, Colombia, Czechoslovakia, Denmark, Egypt, El Salvador, France, Great Britain, Greece, India, Iran, Iraq, Italy, Korea, Luxembourg, Mexico, Netherlands, Nicaragua, Norway, Palestine, Panama, Peru, Philippines, Portugal, Siam, Sweden, Switzerland, Tunisia, Turkey, Union of South Africa, United States, Uruguay, and Venezuela.

Representatives from Austria, Cuba, Ecuador, Paraguay, Java, Hungary, and Russia, though named and expected, did not attend. Ethiopia, Lebanon, Dominican Republic, Eire, Finland, Saudi Arabia and Yemen, Afghanistan, Liberia, Costa Rica, Honduras, Poland, New Zealand, and Bulgaria indicated active interest in international cooperation in cancer research.

This means that 60 nations answered the call issued through the State Department. The U. S. attendance was excellent, making a total registered membership of 816.

Unification was provided by holding all the meetings on the first and second floors of one hotel, The Jefferson. In this way many people, often talking different languages but having the common ambition of discovering new facts about cancer, helped each other in ways too numerous to mention. The meetings did not drag and become monotonous because there was so much from which to choose. Shields Warren, chairman of the Program Committee, ably seconded by the vice-chairman, Sidney Farber, supplied a program of great variety. A general session of comprehensive and fairly long papers and five smaller special sessions of shorter reports on cancer were in simultaneous operation. Also attracting many was a splendid series of exhibits arranged by G. W. Larimore, chairman of exhibits. These demonstrations of new techniques, methods, and results were of great help to those planning their own experiments, and the showings of well-chosen motion pictures, also provided by Dr. Larimore, gave inspiration and relaxation. Important also were the informal discussions on easy chairs in the corridors situated close to both the exhibits and the scientific meetings.

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[1] Professor of Anatomy, Washington University, and Director of Research, Barnard Free Skin & Cancer Hospital, St. Louis.

The atmosphere of friendly give and take was carried into the late afternoons and evenings by the enterprise and devoted service of the Local Arrangements Committee, under A. N. Arneson and Lt. Col. E. C. Sibley, which operated in five subcommittees: *Delegates and Foreign Investigators:* chairman, James F. Nolan; *Foreign Consulates:* chairman, Alphonse McMahon; *Women's Entertainment:* chairman, Mrs. Wendell G. Scott, and co-chairman, Mrs. Frank R. Bradley; *Entertainment:* chairman, Wendell G. Scott; *Local Transportation:* chairman, Col. A. M. Libasci.

In addition, there was a large Reception Committee of 38 St. Louis doctors. Much entertainment in private homes gave evidence of hospitality. The bringing together of large groups in the evenings was accomplished by three dinners in the hotel, a fine supper given by St. Louis University, and a special performance of the Little Symphony, offered by Washington University.

Those attending will not be surprised that it took almost exactly a year to make preparations for the Congress. First, W. U. Gardner, president of the American Association for Cancer Research, consulted the National Research Council and received the permission of the U. S. Department of State. He then invited the Union International Contre le Cancer, through its president, Justin Godart, to join the Association in sponsoring the Congress. All winter and spring the organization of the Congress was developed by these Committees: *Local Arrangements:* chairman, A. N. Arneson, and vice-chairman, Lt. Col. E. C. Sibley; *Finance:* chairman, S. Bayne-Jones; *Exhibits:* chairman, G. W. Larimore; *Governmental Liaison:* chairman, L. H. Scheele; *Publicity:* chairman, M. G. Seelig; *Program:* chairman, Shields Warren, and vice-chairman, Sidney Farber.

From August 4 to September 27 Frank McGurk, loaned to us by the National American Red Cross, served most effectively as full-time secretary general. It would have been greatly to the advantage of the Congress if he could have come earlier and stayed longer.

It will be asked what precisely were the objectives of the Congress beyond meeting old friends, making new ones, and the resulting cross-fertilization of ideas. There were two purposes: first, to review the recent advances that have been made in cancer on a world-wide front, and, second, to lay the basis for international cooperation so that research can be carried on more effectively. With the encouragement of the President of the United States, it was felt more keenly than before that the eyes of the thinking world were on this international gathering. Because of this fact, the action of the American Cancer Society in delegating a member of its staff, Pat McGrady, a skilled publicity man, to cooperate with Dr. Seelig, publicity chairman, was especially opportune. The press worked loyally under Mr. McGrady. The greatest care was necessary to give the facts without conveying unwarranted hope of the effectiveness of the new and possibly improved methods of treatment reported, because no one knew better than Dr. Seelig how tragically cancer sufferers grasp at straws.

This review of recent advances and up-to-date techniques was timely. The world is in a period of reconstruction. Universities, cancer hospitals, and clinics in some countries have been completely wrecked, while in others work has been carried on with skeleton staffs sadly restricted by lack of equipment and supplies. It is essential that the new buildings to be erected be well planned, that the investigators work with full knowledge of what already has been done, that they have the most effective equipment and adequate supplies of materials such as the radioactive isotopes liberated by President Truman. In other words, to have organized cancer research poorly armed and informed would have been a terrible handicap, especially since it is so difficult, having embarked on a program, to change it or abandon it and start all over again. Our plan is to make the transactions of the Congress available to all by publication in *Acta* under the editorship of J. Maisin, of the University of Louvain in Belgium, but it is now evident that the balance in the treasury of the Congress will be altogether insufficient for this purpose and additional money will have to be secured.

Even briefly to review the results of hundreds of reports to the Congress is not feasible here. Abstracts of many of them are contained in the printed program, itself a volume of 168 pages. Cancer being a condition that can be manifested by a wide variety of cells of the body from before birth to the point of death in more or less remote response to the action of hundreds of influences not only in man but in thousands of animal species, the ground covered by it is greater than by any other disease. No two individuals would give the same appraisal of the advances reported. We are frequently asked, "Well! What really new was reported for the first time at the Congress?" The questioner knows that he may get cancer himself, or he may already have it, and he definitely has in mind prevention, diagnosis, and treatment.

With respect to prevention, cancer hazards are particularly great in certain industries, and detailed recommendations were made for protection. Individual predisposition to cancer was stressed in several papers. Some progress was reported in recognition of the kind of individual most likely to get cancer and of the properties of precancerous conditions that serve as alarm signals. Knowledge of the causes of cancer is to some extent helpful in prevention, and much was said about cancer production. Viruses were considered in detail, but no evidence was given that human cancer is infectious. The nature and operation of the so-called milk factor was elucidated.

The importance of discovering some chemical or microbiological test by which cancer can be detected wherever it exists in the body and earlier than by the methods now in use is universally admitted. Tests based on the examination of the blood and urine of patients suspected of cancer were reported. Further work alone will show their value. The well-known technique of examination of vaginal smears in the diagnosis of uterine cancer was discussed and its wider use indicated. Success in the diagnosis of some lung cancers by examination of cells in the sputum was described. Reports on transplantation technique seemed to strengthen its diagnostic value.

Improvements in treatment of cancer are, of course, most urgently needed. Present hope rests chiefly on early surgical excision of cancer before it has spread through the body. Distinguished radiologists and surgeons reviewed technical procedures and results and outlined future possibilities. Since the logical basis for experiments leading to the discovery of new and different methods of treatment is knowledge of how cancer cells differ from the normal cells from which they spring, these properties were investigated by a host of techniques, and encouraging progress was reported. Many and sometimes favorable attempts to inhibit cancer growth by hormone administrations were discussed. The beneficial effect of tissue extracts on some cancers was claimed. Numerous papers on chemotherapy showed beyond question the value of integrated research on a fairly large scale and the advisability of testing substances wholesale on the chance that some of them may prove effective. Preparations called KR and ACS from Russia, FA from Italy, and H11 from England were exhaustively investigated, but no claim was made that they are the answer to the great question of how to cure advanced cancer. Reports on the new pain-killing drugs, metopon and amidone, were well received.

The Congress showed that chemical and physical techniques are being brought to bear on cancer as never before. We are in a far more advantageous position than at the last Congress in Atlantic City in 1939. Incidentally, the second and first Congresses were held in Brussels in 1936 and in Madrid in 1933, likewise under the Union Internationale Contre le Cancer. At this, the fourth Congress, the importance of the electron microscope, of polarization optical methods, of ultracentrifugation, and of other techniques was manifest, and the new betatron was described. Most significant, perhaps, were the papers and exhibits on radioactive isotopes which served to orient investigators planning to use them in their own researches.

Some, however, had the sobering thought that after the Congress would come a flood of letters from cancer sufferers, told that their cases were hopeless, pleading for information about new cures reported at the Congress, and that each and every one of these inquiries probably would have to be answered by saying that there is still no cure for advanced cancer and that they should trust their physicians.

Yet a feeling of optimism pervaded the meetings. One great scientist marveled at the mass of facts already known about cancer. He remarked that the scientific sessions in some of the rooms were quite beyond him and truly stated that no single human being is capable of an intelligent appreciation of this enormous mass of knowledge. He mentioned the idea that someone gifted with the power of putting two and two together might propose a real cure; that is to say, if we look back some 20 years hence, we may wonder at our dumbness. But he was quick to call for more experiments.

When questioned, some said that atomic energy had been harnessed and that it was only a question of time before advanced cancer, now considered hopeless, would be cured. But these were reminded that it may well be more difficult to solve the cancer problem than to find out how to make an atomic bomb. Others were impressed by the fact that cancer sometimes grows quickly, sometimes slowly, and in extremely rare cases disappears without treatment. They thought that an understanding of the reasons for these phenomena would light the way to purposeful control.

The majority were simply encouraged by the teamwork being developed in cancer research. The old guerrilla warfare against cancer is being replaced by organized research. Yet it was admitted that a good beginning has hardly been made. No actual poll was taken but, rather careful estimates indicated that, of those presenting the results of researches at the Congress, the vast majority were working on cancer only in the time that they could spare in competition with other duties. As long as the offensive against cancer is so predominately a spare-time occupation it will be a half-hearted affair.

Another serious handicap, the magnitude of which was brought out by sample questioning, is that few indeed of the investigators have enough financial backing to feel able to carry on for as long as five years; most of them could count on support for only one year. With such insecurity, the peace of mind necessary for productive research is sadly lacking, and there is a tendency to concentrate on get-the-results-quickly projects, neglecting important long-term ones.

All at the Congress were in favor of international cooperation, though some questioned its feasibility. To lay a satisfactory basis for this in less than a week called for careful thought and prompt action.

Obviously, the 139 representatives from abroad together with the 8 official U. S. delegates constituted a group too large to make much progress, but it was evident that their advice was valuable and should be followed in this, the supremely important task of the Congress, emphasized indeed in the President's message.

These national representatives therefore held an organization meeting on September 2. After free discussion it was decided to assign the duty of making specific recommendations to a smaller group consisting of but one representative of each nation, who would receive counsel and advice from his compatriots. This group, designated the Executive Committee of National Representatives, held meetings on September 3, 4, and 5. In order to spread the responsibility internationally, a representative of the United States, Great Britain, and Mexico acted as chairman, respectively, on these dates. The recommendations prepared were presented on September 6 in English, French, and Spanish to the larger body of National Representatives for approval.

The essential feature of these recommendations was the establishment of a small but representative *International Cancer Research Commission.* It was proposed that the Commission consist of but one member from each of the nations at the Congress and that these have equal voting power, quite irrespective of the size of the nation represented. In order regularly to draw new personnel into the Commission, it was proposed that no member shall serve for more than three years. To decentralize the Commission, it was proposed that the annual meetings never be held consecutively in the same country.

Since the need was felt to build within the framework of an existing international organization in the field of cancer, it was proposed that the Commission be constituted as an almost autonomous division of the Union Internationale Contre le Cancer. Fortunately, members of the Executive Committee of the Union were present at the Congress and formally accepted the Commission on this basis, which was specified in detail. It is expected that the Union will be closely related to the World Health Organization. It was agreed that cancer research is to be interpreted to include all efforts to advance our knowledge of cancer by clinical, experimental, or other means.

It was recommended that single representatives of still other nations be welcome in this Commission, and that a five-member Executive Committee of the Commission be appointed and later be expanded to not more than seven members. To make this Committee representative, it was proposed that it consist of one member from Latin America, one from Asia, one from the United States, and two from Europe, supplemented by alternates to serve in case any of the members was unable to do so. The actual membership suggested was:

I. Millan (Mexico), chairman; alternate, F. Leborgne (Uruguay)

E. V. Cowdry (United States); alternate, W. U. Gardner (United States)

V. R. Khanolkar (India); alternate, Tu-Shan Yung (China)

J. H. Maisin (Belgium); alternate, A. Lacassagne (France)

A. Haddow (England); alternate, J. Engelbreth-Holm (Denmark)

It was understood that Haddow would represent the whole British Empire.

These recommendations, finally presented to the entire Congress on September 6, were enthusiastically and unanimously approved. Consequently, the single representatives from each of the 40 nations at the Congress constituting the charter members of the International Cancer Research Commission, consider that they have a mandate from the Fourth International Cancer Research Congress to proceed along these lines. It is their hope, and we believe that of mankind everywhere, that this Commission soon will be expanded to include the remainder of the 60 nations which responded so cordially to the invitation transmitted by the U. S. Department of State, but were unable actually to take part in the Congress. In addition, and as quickly as possible, the cooperation on the same basis of Japan, Germany, and Spain is urgently needed.

The appointment of new members from these other entering nations as well as replacement of charter members upon their retirement in three years will invigorate the Commission. It was clear, however, that if the majority are replaced after three years by newcomers unfamiliar with the work of the Commission, orderly development and continuity of work will be in jeopardy. For this reason it was decided to suggest to the nations involved that the replacing members attend the last annual meeting of these retiring charter members for experience, but without power to vote.

Not the least benefit derived from the International Cancer Research Commission will flow from the act of choosing members as national representatives in an increasing number of countries all over the world. Everywhere it will honor the individual, dignify cancer research, and strengthen public support for such research. The feeling was repeatedly voiced that the person chosen should be representative of the leading cancer research organization in each country, and it is not unlikely that this will be a factor in the creation of such organizations in nations not already so equipped.

Dr. Millan and his Executive Committee have the immediate responsibility of consolidating the Commission and of securing the financial life blood without which it cannot function. Wise publicity is called for. They will also make a detailed study of objectives and methods of operation and submit this at the next annual meeting of the Commission in 1948 at a time and place soon to be announced. However, it can be said at once that the Commission does not seek in any fashion to control cancer research anywhere. That would be unwarranted intrusion. Rather, I believe it to be the intention of the charter members of the Commission to give advice and some financial assistance when requested and to promote cooperation in cancer research between the nations that welcome it.

No nation, large or small, has a monopoly of wisdom. All can participate in the world problem of discovering more effective means to prevent, diagnose, and cure cancer. Progress in cancer research springs from quality, not quantity. The research front in cancer is so extensive that many small but promising research projects costing but little can be selected as well as large ones. Both are demanded and the sooner the better, for there is urgency. There is also something to be said in favor of holding the annual meetings of the International Cancer Research Commission not where there are comparatively large groups of active investigators but in other countries which thereby may be encouraged more vigorously to organize their resources against cancer. We have great expectations that national frontiers will give way in the pooling of such resources. The vision includes some neighboring countries, unable financially alone to establish and maintain the well-equipped cancer research institutes required for certain lines of inquiry, joining forces for the common good.

Looking back to the feverishly active days of the Congress, it is clear that the *International Cancer Research Commission* developed smoothly because it was something everybody earnestly wanted and because the wisdom of the policy of decentralization, adopted at the very beginning, was self-evident. This policy found expression in equal representation by all nations, in the headquarters of the Commission being temporary and dependent upon the location of the chairman of the Executive Committee of the Commission, and in the decision never to hold annual meetings of the Commission consecutively in the same country. It is safe to say that the charter members of the Commission share with President Truman the hope that international cooperation thus made effective will spread to other problems of world concern.

The 139 representatives of 40 nations returning home from the Fourth International Cancer Research Congress are ambassadors of good will and of hope for all nations. They look forward with pleasure to the Fifth Cancer Congress. No decision was reached as to where this will be held; but, as a decentralization measure, it will certainly not be in the United States. Recommendations as to location will be made to the Union Internationale Contre le Cancer by the International Commission.

Obituary

S. F. Light

1886–1947

The tragic death by drowning of Prof. S. F. Light on June 21, 1947, represents a severe loss to biology. Prof. Light had for 22 years been a member of the Department of Zoology at the University of California, Berkeley.

S. F. Light was born into a Presbyterian minister's family in Elm Mills, Kansas. After graduation from Park College, Missouri, in 1908, he spent two years teaching in government schools in Japan, two in the Manila High School, Philippine Islands, and two as instructor in Zoology at the University of the Philippines, taking a Master's degree from that institution in 1913. Except for one year (1914–15) at Princeton University as Procter Fellow, his service at the University of the Philippines as assistant, associate, full professor, and department head was continuous until 1922. From 1922 through 1924 he served as professor and chairman of the Department of Zoology at the newly organized University of Amoy, China. During these years he published a series of careful systematic studies on Philippine coelenterates, especially alcyonarians and scyphozoans, and on oriental termites. Some of these grew out of expeditions of which one, to Puerto Galero, Mindoro, in 1912, is of special interest, because this site has since been chosen, largely by his students, for the marine station of the University of the Philippines. From Amoy, in addition to material for later termite studies, came accounts of the astonishing amphioxus fisheries of that region. A great body of less tangible results of his contact with tropical faunas enriched his teaching and thinking in later years.

In 1924 Light returned to the States, intending to work for the doctorate and return to the Orient. His work on termites attracted the attention of the late C. A. Kofoid, who persuaded him to remain at the University of California after taking the Ph.D. in 1926 on termite flagellates. At this time his interest in biological aspects as distinct from the purely taxonomic first made its appearance in published work. Besides describing several new genera and species of mastigote protozoa, he actively investigated the specificity of the intestinal faunas of various termite species, both descriptively and experimentally, studying natural and experimental defaunation, refaunation, and transfaunation. He was able to explain the previously reported mitotic flares in the termite gut as normal refaunation after molting, not realizing how close he was to the amazing relations between host molt cycle and protozoan reproductive cycle, recently discovered by Cleveland in roaches.

Much needed systematic work on termites was resumed and protozoa abandoned, however, in 1928, partly due to the large share of responsibility he assumed for the extensive cooperative investigation into all aspects of pure and applied termite biology which culminated in the volume *Termites and termite control* in 1934. During these years he became an international authority on the group, studying in particular the species of the western United States and Mexico, the South Pacific, and the Orient. This phase gave way about 1935 to the one which continued until his death—the analytical and experimental pursuit of problems of social physiology. During the course of a study involving staggering numbers of laboratory colonies of controlled composition, a large proportion of which remains to be published, the unimportance of genetic factors and the large role and much of the mechanism of caste determination by interaction in the social complex have been documented. The discovery of parthenogenesis in termites was one of several incidental results.

As an outgrowth of his teaching and special interest in the ecologic distribution of invertebrates, a program of analysis of the occurrence of species of the important fresh-water copepod genus *Diaptomus* was begun about 1934. First to be accomplished was a necessary systematic revision by which a large and cumbersome genus was satisfactorily divided into many subgenera, using new characters demanding high microscopic magnification. Toward an eventual attempt to explain the distribution, a large and carefully documented collection of western entomostracans was assembled during several years of intensive field work. The great values of such a collection will doubtless be realized in the work of others to come.

Light exercised in his teaching a peculiarly pervasive and long-lasting influence on his students' points of view, interests, and habits of thought. An outstanding characteristic of the introductory course in zoology which he taught for many years was the painstaking guidance of teaching assistants in pedagogical technic and basic biological concepts. His advanced courses, undoubtedly unique in modern invertebrate zoology, were marked, respectively, by a critical, appreciative phylogenetic morphology and a critical natural history which insisted on a full realization of the values of sound systematics, keen field observation, and concrete, testable interpretation. The essence of the natural history course is to be found between the lines of its remarkable syllabus which combines a dynamic field approach to basic ecologic problems and practical aids to the mastery of a specific fauna. One of its peculiar values is the obvious flux or evolution, of which it represents but a stage. Its author always apologetically spoke of it as a highly tentative step toward a very important goal.

Prof. Light played his role in biology and academic life in personal contacts rather than in national or university organs. He profoundly affected the directions and attitudes of many graduate students and exerted a marked and constructive influence in departmental affairs. His intimates will remember the personal qualities of modesty —extending to a real underestimation of self and as real an appreciation of disciplines which he regarded as beyond his ken (viz., optics, biochemistry), of exacting criticism in the use of words and ideas—driving him now to caution, now to very forward positions, of sincere interest in the human relations of all his assistants and students and of a highly developed aesthetic enjoyment of outdoor beauty. Many will feel that, although they never really knew the inner man, they learned vividly the goals and standards for which he lived.

T. H. Bullock

University of California, Los Angeles

NEWS *and Notes*

Lee A. DuBridge, president, California Institute of Technology, **E. O. Lawrence,** University of California, and **O. M. Solandt,** National Defense Board, received honorary D. Sc. degrees from the University of British Columbia at its 21st Fall Congregation, October 29. Dr. DuBridge delivered a lecture on "Science, the Basis of Industry" and also participated in a nuclear physics symposium at which he presented a paper, "The Atomic Age Isn't Yet Here."

Robert E. Marshak, associate professor of physics, University of Rochester, is now in Paris, where he will attend an international meeting of nuclear physicists, the first such gathering since World War II, to discuss nuclear physics and its social implications. The Paris conference, sponsored by the French Government, UNESCO, and various French scientific organizations, will also commemorate the 10th anniversary of the death of Lord Rutherford, distinguished British nuclear physicist. Dr. Marshak, chairman of the Federation of American Scientists, will represent that group at the conference.

F. R. Eirich, research associate, Department of Colloid Science, Cambridge University, England, has been appointed assistant professor of colloid chemistry, Polytechnic Institute of Brooklyn. During the war, Dr. Eirich won recognition from the British Government for his research on explosives.

Paul R. Cannon, professor and chairman, Department of Pathology, University of Chicago, will deliver the Third Richard H. Jaffé Memorial Lecture of the Institute of Medicine of Chicago, November 28, at the Palmer House, on the topic, "Tissue Synthesis as a Problem in Pathology."

Harry Seneca, research associate, College of Physicians and Surgeons, Columbia University, and consultant to Schering Corporation, recently flew by special plane to Cairo to assist in the control of the cholera epidemic and to study the methods employed in the treatment of the disease. He is cooperating in this study with the Division of Clinical Research of Schering Corporation.

William G. Pollard, formerly professor of physics, University of Tennessee, has been appointed executive director, Institute of Nuclear Studies, Oak Ridge. Dr. Pollard has been acting director of the Institute since February.

Visitors to U. S.

A. T. Knoppers, pharmacologist, Cinchona-Instituut, Amsterdam, Holland, arrived in New York November 17 for a tour of medical schools in this country and also to attend scientific meetings. He can be addressed in care of the Cinchona Products Institute, Inc., 10 Rockefeller Plaza, New York 20, New York.

A. K. Longair, of the Department of Scientific and Industrial Research, is expected to arrive in this country at the end of this month to take up his duties as assistant director of the United Kingdom Scientific Mission, Washington, D. C.

Grants and Awards

Cledo Brunetti, chief, Engineering Electronics Section, National Bureau of Standards, has received the award for engineering achievements given annually by the magazine *Materials and Methods*. Dr. Brunetti was honored for his wartime development of "printed" electronics circuits, which opened the way to the Army and Navy VT proximity fuse.

Glenn T. Seaborg, professor of chemistry, University of California, and co-discoverer of plutonium, will be awarded the 1948 William H. Nichols Medal of the New York Section, American Chemical Society, at a joint meeting of the Society's New York Section and the American Section of the Society of Chemical Industry, to be held March 5 at Hotel Pennsylvania, New York. The Nichols Medal, conferred annually to stimulate original research in chemistry and considered one of the highest honors in chemical science, was founded by the late William H. Nichols, a charter member of the American Chemical Society, and chairman of the board, Allied Chemical and Dye Corporation. It will be presented to Prof. Seaborg for his research on plutonium, and his participation in the discovery of americium and curium, and numerous artificial radioactive materials.

The Department of Physics, Case Institute of Technology, has received grants totaling $11,000 from the Research Corporation of New York. A grant of $6,000 will be used to complete the construction and the auxiliary equipment of the betatron which will be finished this year. The betatron was designed and supervised by **Earle C. Gregg, Jr.,** Department of Physics. A grant of $5,000 is intended for the development of new instruments and techniques to be used in connection with the betatron, a project which will be under the direction of **Erwin F. Shrader,** associate professor of physics, whose researches will be aimed at making the most effective use of the betatron, particularly in the development of electron multiplier tubes. These grants from the Research Corporation supplement a grant of $7,000 given last year for the betatron project.

Fellowships

Gilbert H. Fletcher, formerly resident and instructor in radiology, New York Hospital and Cornell Medical School, and roentgenologist, U. S. Army, during the war, has been appointed Traveling Fellow in the Department of Radiology, University of Texas, M. D. Anderson Hospital for Cancer Research. Dr. Fletcher is now making a study of European institutions which are devoted primarily to radiological investigation and treatment. During his tour, he will obtain data on the use of X-ray, radium, and other radioactive materials in the treatment of cancer in European countries and will visit the Radiumheminet of Stockholm, the Royal Free Cancer Hospital, London, the Institute of Radium, Curie Foundation, Paris, and many other institutions. The creation of a traveling fellowship establishes a precedent at the M. D. Anderson Hospital and at the Texas Medical Center. An exchange plan is being developed whereby students of cancer from all parts of the world may come to the Hospital for brief courses of training and consultation, and, in return, Hospital personnel may visit the outstanding institutions abroad.

Fifteen young investigators in the medical sciences were awarded travel fellowships to attend the International Physiological Congress held last summer at Oxford. Funds for five of these awards came from the income of the Trust Fund for the International Physiological Congress, of which the American Physiological Society is custodian. Ten additional fellowships were made possible by a Rockefeller Foundation grant. The 15 men so honored were: S. B. Barker, associate professor of physiology, University of Iowa; Alfred F. Bliss, assistant professor of physiology, Tufts College Medical School; Paul D. Boyer, assistant professor of biochemistry, University of Minnesota; William H. Fishman, research associate in biochemistry, University of Chicago; Robert G. Grenell, instructor of neuroanatomy, Yale University; Morton I. Grossman, assistant professor of physiology, University of Illinois; Carl G. Heller, associate professor of physiology, University of Oregon; Robert Hodes, associate in biophysics, The Eldridge Reeves Johnson Foundation for Medical Physics, University of Pennsylvania; William G. Kubicek, assistant professor of physiology, University of Minnesota; Gordon K. Moe, associate professor of pharmacology, University of Michigan; R. R. Overman, assistant professor of physiology, University of Tennessee; John R. Pappenheimer, associate in physiology, Harvard Medical School; Walter Franklyn Riker, Jr., instructor in pharmacology, Cornell University Medical College; James V. Warren, assistant professor of medicine, Yale University; and Earl Wood, assistant professor of physiology, Mayo Foundation, University of Minnesota.

Colleges and Universities

Harvard University has appointed a Faculty Committee to plan peacetime jobs for Harvard's most complex calculating machine which is still under contract to the Navy, but which works on peacetime computations during a part of every day. The membership, which will assure that problems of all fields will be considered, consists of Paul H. Buck, provost *(chairman)*; Edward Reynolds, administrative vice-president; Gordon M. Fair, dean of engineering; James S. Simmons, dean, School of Public Health; Howard H. Aiken, professor of applied mathematics and director of the Computation Laboratory; Garrett Birkhoff, professor of mathematics; Howard W. Emmons, associate professor of engineering science; Wassily W. Leontief, professor of economics; Donald H. Menzel, professor of astrophysics; Julian S. Schwinger, professor of physics; and Samuel A. Stouffer, professor of sociology and director, Laboratory of Social Relations.

The University of California, Division of Entomology and Parasitology, has recently appointed the following men to its faculty: **Merlin W. Allen,** assistant professor of entomology and assistant nematologist, Experiment Station; **Deane P. Furman,** assistant professor of parasitology and assistant parasitologist, Experiment Station; **James R. Douglas,** assistant professor of parasitology and assistant parasitologist, Experiment Station at Davis; **Harold T. Gordon,** assistant insect toxicologist, Experiment Station; **Dilworth D. Jensen, Woodrow W. Middlekauff,** and **A. Earl Pritchard,** assistant professors of entomology and assistant entomologists, Experiment Station; **Ray F. Smith,** instructor in entomology and junior entomologist, Experiment Station; **Francis M. Summers,** principal laboratory technician, Davis; and **Edward S. Sylvester,** instructor in entomology and junior entomologist, Experiment Station.

The Johns Hopkins University has begun construction of a new two-story building intended principally for the School of Engineering and other scientific departments. The building will be named Whitehead Hall, in honor of John Boswell Whitehead, now actively engaged in research as professor emeritus of engineering. Dr. Whitehead served as dean of the School of Engineering from 1920 to 1938 and director from 1938 to 1942, when he received his present appointment. Whitehead Hall will be the first structure at the University to be named for a living person.

Ohio State University scientists have succeeded in concentrating a rare form of helium, "mass 3 isotope," by means of a single-step process. Mass 3 isotope usually exists in the proportion of one part to a million of the normal "mass 4 isotope." The single-step process makes use of mass 4 helium's ability to climb out of its container at low temperatures by means of "film flow," which takes place through a surface layer of liquid helium which forms on the walls of the container. It was found that only the normal mass 4 helium atoms undergo this film flow at a temperature of 1½° above absolute zero, while the rarer mass 3 atoms remain behind. Since the natural abundance of mass 3 isotope is so small, a huge volume of the element will have to be processed in order to obtain a small quantity of pure mass 3 helium required for further research. The project was carried out by **J. G. Daunt, R. E. Probst,** and **H. L. Johnston,** all of Ohio State. **E. O. Nier,** University of Minnesota, collaborated in some of the early phases of the work. The project is being supported by the Office of Naval Research under contract with the Ohio State University Research Foundation, as one of 6 Navy projects now under way in the Ohio Cryogenic Laboratory.

Meetings

The Fourth Annual Conference on Protein Metabolism, sponsored by the Bureau of Biological Research, Rutgers University, will be held in New Brunswick, New Jersey, February 6–7, 1948. Two sessions on Friday and one on Saturday are planned, at each of which two lectures will be given. Subjects of discussion will be intermediary protein metabolism, accessory substances, endocrine relationships, and therapeutic aspects. The Conference is open to all those interested whose registration is received by January 24. Blanks may be obtained from William H. Cole, Rutgers University. Final arrangements will be announced to registrants by January 28.

The Faraday Society, 6 Gray's Inn Square, London, W. C. 1, is planning a General Discussion on "The Physical Chemistry of Process Metallurgy" for the latter half of September 1948. It is proposed that the discussion will be devoted to the thermodynamics and kinetics of the high-temperature reactions involved in smelting and refining, thus excluding reactions occurring in mechanical working and heat treatment as well as electrochemical processes in aqueous solutions. Thermodynamics will include thermochemical, free energy, and equilibrium studies; kinetics, both chemical reactions and diffusion processes. Readers of *Science* who are interested in attending are invited to forward to the secretary, G. S. W. Marlow, summaries of papers indicating subject matter and method of treatment not later than February 1, 1948. By March 1 prospective contributors will hear concerning the acceptability of their papers.

Elections

The State College of Washington chapter of Sigma Xi, Pullman, Washington, recently elected the following officers for the current year: H. L. Eastlick, Department of Zoology, president; D. L. Harris, Division of Industrial Research, vice-president; H. Bang, School of Pharmacy, secretary; C. M. Stevens, Department of Chemistry, treasurer; and C. S. Holton, pathologist, U. S. Department of Agriculture, Executive Committee.

The American Association of Colleges of Pharmacy elected the following officers at its annual meeting held in conjunction with the American Pharmaceutical Association, August 24–30, in Milwaukee, Wisconsin: Arthur Uhl, Madison, Wisconsin, president; J. Lester Hayman, Charleston, West Virginia, president-elect; John F. McCloskey, New Orleans, vice-president; and Louis C. Zopf, Iowa City, secretary-treasurer. New members of the Executive Committee are: J. B. Burt, Lincoln, Nebraska, and H. C. Newton, Boston. B. V. Christensen, Columbus, Ohio, was re-elected chairman of the Committee.

The Biological Photographic Association elected the following officers for 1947–48 at its 17th annual meeting in Rochester, New York: president, Edmond J. Farris, executive director, The Wistar Institute; vice-president, Oscar W. Richards, chief biologist, American Optical Company; secretary, Anne Shiras, Department of Medical Photography, University of Pittsburgh; and treasurer, Stella Zimmer, Department of Medical Photography, Syracuse University.

NRC News

A Building Research Advisory Board, under the chairmanship of Frank B. Jewett, formerly president, Bell Telephone Laboratories, Inc., and during the war, president of the National Academy of Sciences, has been established as a unit of the Division of Engineering and Industrial Research. The Board will serve as a central clearinghouse for information on scientific research in the building construction industry, stimulate correlation of research information and coordination of research activities in its fields of interest, assist in dissemination of information on advances in design, materials, methods, and technologies of building construction, and in general further the application of scientific methods for the improvement of building construction practices. Board membership is made up of over 20 academic, industrial, and government men in the fields of scientific research, architecture, engineering, and building construction. The Board, established at the specific request of the Construction Industry Advisory Council of the U. S. Chamber of Commerce, will work closely with a Research Activities Committee of that Council.

The Committee on Drug Addiction has been reorganized as the Committee on Drug Addiction and Narcotics with the following membership: Isaac Starr (chairman), Hon. H. J. Anslinger, Raymond N. Bieter, Dale C. Cameron, Nathan B. Eddy, W. W. Palmer, Maurice H. Seevers, and Lyndon F. Small. At its first meeting on October 2 the Committee elected Dr. Eddy as secretary, with authority to conduct the current studies on metopon. The several problems regarding stock-piling of narcotics as presented by the Surgeons General of the Army and Navy were discussed and definite recommendations agreed upon. It is expected that this Committee will have a very important function in regard to the testing and use of derivatives of amidon now being prepared by the pharmaceutical houses.

Recent Deaths

J. Lindhard, 77, emeritus physiologist of the University of Copenhagen, died October 11 following an operation. Among exercise physiologists he is best known for joint authorship with August Krogh of a series of papers on circulation and respiration, published from 1912 to 1920.

Henryk Hoyer, 83, professor emeritus of comparative anatomy, Jagiellonian University, Kraków, Poland, died October 17. Prof. Hoyer was widely known for his work on the comparative anatomy of blood and lymph vessels of vertebrates.

Clarence O. Cheney, 60, formerly medical director, New York Hospital, Westchester Division, and professor of clinical psychiatry, Cornell University Medical College, died November 4 in the White Plains Hospital following a cerebral hemorrhage.

In pursuance of the provisions of the "Plenary Powers" Resolution adopted by the International Congress of Zoology at Monaco in March 1913, notice is hereby given that the International Commission on Zoological Nomenclature has received the undermentioned applications for the suspension of the *Règles Internationales* on the ground that their strict application would clearly result in greater confusion than uniformity:

(1) **Suppression of books:** to suppress the names in Gesner, 1758, *Tractatus physicus de petrificatis* (146) and in Hope, 1836, *Buprestidae* (57).

(2) **Class Sporozoa:** to validate the current use of the names *Piroplasma* and *P. annulatum*, commonly attributed to Dschunkowsky & Luhs, 1904 (12).

(3) **Class Hydrozoa:** to suppress the name *Graptolithus* Linnaeus, 1768, and to validate the names *Monograptus* Geinitz, 1852, and *Retiolites* Barrande, 1850 (11).

(4) **Class Cephalopoda:** to validate the name *Octopus* Cuvier, 1797 (187); to fix the type of *Ammonites cordatus* Sowerby, 1813 (58).

(5) **Class Brachiopoda:** to validate the use of the trivial name *pecten* for the Silurian brachiopod commonly known as *Strophomena pecten* (Linnaeus 1758) (130).

(6) **Class Pelecypoda:** to preserve the existing usage *Erycina* Lamarck, 1805 (69); to emend the spelling of *Palaeneilo* Hall, 1869 (62).

(7) **Class Insecta, Order Coleoptera:** to validate the current use of the names: *Bradycellus* Erichson, 1837; *Carabus* Linnaeus, 1758; *Harpalus* Latreille [1802–03]; *Ophonus* Stephens, 1827; *Lebia* Latreille [1802–1803]; *Tachys* Stephens, 1828; *Trechus* Schellenberg, 1806 (158); to emend the spelling of *Hygrioba* Latreille, 1804 (159).

(8) **Class Insecta, Order Hemiptera:** to validate the currently accepted use of the names of the following genera: *Aquarius* Schellenberg, 1800; *Bellocoris* Hahn, 1834; *Beosus* Amyot and Serville, 1843; *Catoplatus* Spinola, 1837; *Dictyonota* Curtis, 1827; *Gastrodes* Westwood, 1840; *Oncotylus* Fieber, 1858; *Pachylops* Fieber, 1858; *Pilophorus* Hahn, 1826;

Tetyra Fabricius, 1803 (144); to validate specified uses of the names *Alydus* Fabricius, 1803, and *Salda* Fabricius, 1803 (161).

(9) **Class Insecta, Order Hymenoptera:** to suppress the name *Clavellarius* Olivier, 1789 (120); and to validate specified uses of the following names: *Ceratina* Latreille, 1802–03; *Diodontus* Curtis, 1834; *Formica* Linnaeus, 1758; *Camponotus* Mayr, 1861; *Gorytes* Latreille, 1804; *Hoplisus* Lepeletier, 1832; *Harpactus* Shuckard, 1837; *Macropis* Panzer, 1806–09; *Megilla* Fabricius, 1804–05; *Megachile* Latreille, 1802; *Methoca* Latreille, 1804; *Notozus* Förster, 1853; *Nysson* Latreille, 1796; *Odynerus* Latreille, 1802–03; *Ponera* Latreille, 1804; *Rhopalum* Stephens, 1829; *Solenius* Lepeletier & Brullé, 1835 (135); to preserve the trivial components of the specific names *Vesper arvensis* Linnaeus, 1758, and *Apis agrorum* Fabricius, 1789 (135).

(10) **Class Insecta, Order Lepidoptera:** to remove doubts regarding the validity of the following Fabrician names published in 1807: *Apatura*, *Castnia*, *Emesis*, *Helicopis*, *Neptis*, *Urania* (148).

(11) **Class Pisces:** to validate the name *Raphistoma* Rafinesque, 1815 (145).

(12) **Class Mammalia:** to determine the type of *Chinchilla* Bennett, 1829 (141).

(13) **Class Cephalasidomorphi:** to validate the current use of *Tremataspis* Schmidt, 1866, by designating *T. schmidti* Rohen, 1892 as its type (123).

(14) **Class Aves:** to fix the type of *Dinornis novae-zealandiae* Owen, 1843 (136).

The undermentioned applications may also involve the suspension of the *Règles* for their solution:

(a) **Class Gastropoda:** *Acmaea*, *Acme*, and *Acmea* (27).

(b) **Class Insecta, Order Coleoptera:** *Leiodes* Latreille, 1796 (64).

(c) **Class Insecta, Order Hemiptera:** *Corixa* Geoffroy, 1762 (137).

(d) **Class Arachnida, Order Acarina:** *Liodes* Heyden, 1826 (64).

(e) to determine the status of Martin (W) 1809, *Petrificata derbiensia* (147).

Zoologists wishing to comment on any of the above applications are particularly requested, when communicating with the Commission, to quote the file number which appears in parentheses at the end of each entry in the foregoing list. Full particulars in regard to all the above items, except the first item in (4), have been published in the *Bulletin of Zoological Nomenclature*. Particulars in regard to (4) will be found in the appendix to Opinion 166. All communications in regard to the above cases should be addressed to the Secretary to the International Commission on Zoological Nomenclature, Francis Hemming, 83 Fellows Road (Garden Flat), London, N.W.3, England.

The American Statistical Association, 1603 K Street, N. W., Washington 6, D. C., is now publishing *The American Statistician*, which replaces the *ASA Bulletin* as the news publication of the Association. The new journal, to appear each year in February, April, June, August, October, and December, under the editorship of **Sylvia Castleton Weyl,** will supplement the Association's technical publications and serve as an editorial medium, will present discussions of the uses of statistical methods in various fields, and will open its columns to questions and answers as well as to the presentation of problems. The first issue appeared in August. The subscription price is $1.50 or 25¢ a copy.

November 3 and 4 marked two anniversaries of interest to scientists. **John F. Fulton,** of Yale University School of Medicine, who is delivering the Heath Clark Lectures in London this month and who was the only American attending the events, has forwarded to *Science* the following accounts:

In Greyfriars' Churchyard at Edinburgh on November 3 there was a simple but impressive ceremony at the grave of James Hutton, M.D., F.R.S.E. (1726–97), commemorating the 150th anniversary of his death. Eloquent tribute was paid to "the founder of modern geology" by Lord Provost Sir John Falconer and by the Rev. Dr. D. W. P. Strang of Greyfriars as a tablet was unveiled to his memory.

In the afternoon Sir Edward B. Bailey, F.R.S., delivered a memorial address to the Royal Society of Edinburgh, emphasizing particularly Hutton's unpublished *Principles of agriculture*, far less well known than his classic *Theory of the earth*. Were the "Principles" to be published today, it would take its place among the great books of science. The subject matter is comprehensive—for example, one sentence from a discussion of possible diversification of species by natural selection reads: "Where dogs are to live by the swiftness of their feet and the sharpness of their sight, the form best adapted to that end will be the most certain of remaining, while those forms which are the least adapted to this manner of chase will be the first to perish." This was written by a man who died 11 years before Charles Darwin was born.

In all his writings Hutton saw the working of a single great idea, a balance of the powers of Nature which led to never-ending cyclic continuity. When he noted destruction in one direction, he found proof of reconstruction in another. In the words of the Lord Provost when unveiling the memorial tablet: "It is for us to be grateful to men like Hutton, whose patient endeavours have made for the progress of the world. He developed geological ideas far in advance of his time."

On November 4 there was another anniversary of interest to scientists the world over. It was just 100 years since Prof. James Y. Simpson and two assistants had sat around the dining table of his house at 52 Queen Street and inhaled the fumes of chloroform. The memorable event has been marked at Edinburgh by appropriate ceremonies, beginning with a scientific meeting at which the use of chloroform at the present date was discussed by R. R. Macintosh, D. S. Middleton, and John Gillies. Honorary degrees were conferred upon Henry Walter Featherstone, founder-president of the Association of Anaesthetists of Great Britain, and Thomas Blantyre Simpson, K.C., grandnephew of Sir J. Y. Simpson. In the afternoon there was an address by Douglas Guthrie, author of *The history of medicine*.

The house of Simpson, whose use of chloroform to ease the pain of childbirth was decried by the clergy, has now been turned over to the Church of Scotland to be used as a center for the training of youth in Christian leadership.

The Office of Technical Services, Department of Commerce, has released for sale the third volume of a comprehensive *Index* to the thousands of reports on wartime technological developments in the United States, Germany, and other foreign countries, which is intended for use with the *Bibliography of scientific and industrial reports*, which has been published weekly since January 1946. The third volume of the *Index* provides a reference to the issues of the *Bibliography* from October 4 to December 27, 1946, and also includes reference to the German patents in chemistry, electronics, scientific instruments, photographic equipment and processes, and transportation equipment which were listed in the *Bibliography* during this period. The *Index* is elaborately cross-referenced, and each entry lists the file number of the report and the page number of the *Bibliography* where an abstract of the report may be found. The three volumes of the *Index* (35¢ each for Vols. 2 and 3, and 50¢ for Vol. 1), and the *Bibliography*, which is $10 a year, may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by check or money order, payable to the Treasurer of the United States.

The 10th six-week course in the Laboratory Diagnosis of Parasitic Diseases will be given January 12–February 20, 1948, by the Laboratory Division of the Communicable Disease Center, U. S. Public Health Service, 291 Peachtree Street, Atlanta, Georgia. The course is given primarily for the Division's laboratory personnel and that of state and local public health departments, but applicants from hospitals and private laboratories will be gladly considered if there are vacancies. There is no tuition fee, but living and travel expenses must be assumed by the individual. Two other similar courses will also be given July 12–August 20, and October 11–November 19, 1948. Applications for all courses should be made as far in advance as possible. Notification of acceptance will be made about two months before each course begins so that states may have time to arrange budgetary allotments. Laboratory directors and senior staff members wishing to attend any of these courses may do so. However, it is proposed to schedule one or two short courses in the same subject for these individuals. Definite dates for these two-week courses have not been set. Those interested should notify the Laboratory Division which of the following dates would be most suitable for them, giving first and second choice: March 8–19; May 10–21; and December 6–17, 1948.

The Building Research Station, Department of Scientific and Industrial Research, Great Britain, is making a thorough study of homes to discover the maximum comfort that can be achieved with a minimum amount of fuel, a project of great importance in Great Britain's present fuel crisis. Two large-scale experiments are being carried out. The first, which is concerned with thermal insulation of houses, is being undertaken on 8 specially built similar houses with identical heating systems but different types of insulation. Families have been living in the houses for more than a year while the experiments continue. The reverse conditions are present in the second experiment of 20 houses with similar insulation but different heating systems. In the initial part of each experiment, the houses are occupied only by a theoretical family consisting of four people. The amount of all in-coming and out-going heat is recorded, and 92 different electrical appliances are tested. In the second part of the experiment, real tenants continue recording the necessary data, but do not, of course, have to follow the pattern of the theoretical family. As the result of these experiments, it will be possible to deduce what appliances and methods of construction are best. It is already possible to give such advice on the basis of the initial laboratory experiments, but these must first be tested under actual living conditions before the results will be freely available to the building industry and the public.

The U. S. Atomic Energy Commission has appointed a Board of Consultants to help speed the development of atomic power plants and industrial opportunities in the atomic energy field. Chairman of the Board is James W. Parker, president and general manager, Detroit Edison Company. Other members include: O. E. Buckley, president Bell Telephone Laboratories, New York; Donald Carpenter, vice-president, Remington Arms Company, Bridgeport, Connecticut; Gustav Egloff, director of research, Universal Oil Company, Chicago; Paul Foote, executive vice-president, Gulf Research and Development Company, Pittsburgh; Robert G. Wilson, chairman of the Board, Standard Oil Company of Indiana, Chicago; and Walker Cisler, chief engineer of power plant, Detroit Edison Company, and consultant to the AEC, who will serve as executive secretary of the Board.

The Veterans Administration has established a Laundry and Textile Laboratory at Bedford, Massachusetts, Veterans Administration Hospital, which, by testing and evaluating supplies, preparing specifications and technical bulletins, developing proper and improved cleaning practices, conservation of textiles and determining their suitability to resist cleaning operations, and distributing a laundry test bundle for operation control purposes, will exercise technical control over the 100 hospital laundries and 20 hospital dry-cleaning plants now operated by the Veterans Administration throughout the country. **Hubert C. Normile,** formerly head, Chemical and Plastics Section, Research and Development Division, Philadelphia Army Quartermaster Depot, is technologist in charge of the new laboratory, which will later be located at the new Franklin Delano Roosevelt Hospital, now under construction at Peekskill, New York.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago 16, Illinois, list the following wanted chemicals: benzyl hyponitrite; galactoflavin; di-α-pyridylamine; 3,4,5-trihydroxyphenanthrene; coniferin; α-truxillic acid; β-truxinic acid; cis cinnamic acid; 3,5-dibromosalicylaldehyde; 2-methyl-3-hydroxy-4-pyrone; p,p′-dibutyldiphenyl sulfide; chlorogenine; digitogenine; methyl chloramine; ethyl chloramine; 2-pyridoin: 2-pyridylaldehyde; barium hypobromide; pyrotartaric acid; brazan; mescaline; and eicosyl alcohol.

Make Plans for—

American Mathematical Society, November 28–29, Washington University, St. Louis, Missouri.

American Society of Mechanical Engineers, December 1–5, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

National Council of Geography Teachers, December 27–29, Charlottesville, Virginia.

American Society for Professional Geographers, December 27–30, Charlottesville, Virginia.

American Anthropological Association, December 28–31, Albuquerque, New Mexico.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

COMMENTS
by Readers

During the war and throughout the two years since its conclusion, the problem of the study of foreign languages, as related to scientists in general, has taken on new importance. At no time in history has it been so necessary to keep abreast of the technological developments of foreign countries as now. This fact, coupled with the tendency of students to avoid the serious study of foreign languages, makes it advisable to review the problem briefly, with particular emphasis on the language requirement for the Ph.D. degree. The war initiated intensive methods into the study of languages. It became necessary for more persons to know foreign languages and to know them better than previously. The rather large number of persons who had "passed" German and French at some previous time in fulfilling the requirements for the Ph.D. found that their knowledge of the languages was entirely inadequate. As a consequence, it now appears to many that in the field of science something should be done to rectify the situation.

There are two obvious difficulties in the present method. One is that the scientist often does not come into contact with foreign languages—except for the high school exposure, if any—until he has passed beyond the M.S. degree. Second, his contact with languages in the Graduate College is insufficient to be of any real use to him. Two alternatives exist: either the language requirement can be eliminated or more intensive training in one language can be substituted. The first alternative is contrary to the present trend and necessity; the second suffers from lack of support on the part of educators concerned with the particular problem. In support of the second alternative there may be listed the following:

(1) The student may make effective use of the language earlier in his school career.

(2) A good knowledge of one language has a cultural value which the M.S. or Ph.D. in science cannot afford to miss, especially in this era when scientists must take a greater part in world affairs.

(3) The student is released from the wasteful procedure of cramming for two language exams which he has come to look upon as mere formalities.

Assuming that one language would be acceptable for the Ph.D. requirement, it is, of course, a problem to make a selection. One may attempt to determine the most useful language, from a technical standpoint, by statistical means, but it must not be assumed that every student should be required to study the most widely used language. A balance must be maintained so that all the useful languages are reasonably well represented in any department at any one time. On the other hand, a student should not be required to take a minor language just to maintain some kind of a percentage balance.

It seems that the bases upon which to select languages should be somewhat as follows:

(1) What language will be of most use to the student in his field?

(2) In what language is the student particularly interested?

(3) Which languages does the student already know?

The first of these questions can be partially answered by making a survey of the frequency of references to articles in foreign languages appearing in abstract journals. As an illustration, the references to technical articles for one year, 1940, in the *Wireless Engineer* have been checked in the fields of wave propagation, circuit theory, electronics, and transmission with the following result: German, 100 references; Russian, 57; French, 48; Italian, 23.

In any particular case, with information such as this for the field under consideration, the adviser may come to a satisfactory agreement with the student concerning his language requirement. The question is of such importance that every effort should be made to readjust the treatment of the language requirement not only for the Ph.D. degree but for science students in general. (L. A. WARE, *State University of Iowa.*)

In a report entitled "Calcium and Growth in Aging and Cancer" (Albert I. Lansing. *Science*, August 29, p. 187) data are given regarding the calcium content of cells. These data clarify some aspects of aging and, at the same time, explain the reason for the low calcium content of cancer cells. However, the clarification introduces new difficulties. The paradox is revealed that cancer, an actively growing young tissue low in calcium, occurs spontaneously most frequently in an old tissue high in calcium and which is no longer actively growing. More than this, in young organisms, relatively low in calcium, cancer occurs with far less frequency. It does not help to say that locally rejuvenated old tissue growing in an old organism might be expected to create havoc, for it has been demonstrated time and again that embryonic tissue transplanted in older tissue does not behave at all like cancer, even though embryonic tissue has a low calcium content. Nor can a lack of cell adhesiveness be incriminated to explain malignancy. The reduction of adhesiveness of fibrous tissue cells does not render them malignant. Malignancy, characterized by a direct destructive action by cancer cells upon somatic cells, is not duplicated by wandering, actively growing somatic cells. Therefore, although the decreased adhesiveness of cancer cells can be correlated with their markedly low calcium content, their *destructive* invasiveness cannot be thus explained.

Malignancy is an inherent property of cancer cells independent of their calcium content. On the other hand, increase of the calcium environment of cancer cells may increase their adhesiveness and consequently possibly decrease their invasiveness and thus limit their malignancy by limiting their movement. This might constitute a rational basis for the use of calcium in cancer therapy, as is occasionally recommended.

The reduction of calcium in methylcholanthrene-induced epidermal hyperplasia does not represent a necessary herald of the onset of cancer, for hyperplastic tissue is young tissue, and its calcium content is relatively low.

The low calcium content of cancer tissue simply accompanies its youth and does not explain its malignancy. It is therefore not logical to imply a lineage between cancer cells and somatic cells on the basis of a decreasing content in cell calcium. The behavior of cancer cells negates the proposition that they represent an extrapolation of somatic cells unless a marked saltatory change is assumed. But this assumption requires the additional postulate that a young, aggressive, low-calcium cell can result from a qualitative transformation of an old, passive, high-calcium cell and that this singular process takes place with astonishing regularity and with far greater ease than a similar transformation into a cancer cell of a young, actively growing somatic cell likewise low in calcium.

The fundamental behavior and properties of cancer cells are more fruitfully compared with another primitive tissue—the mammalian trophoblast or, more generally speaking, the asexual generation of the vertebrate life cycle. In making this comparison it is not necessary to resort to postulates not already well established. (Charles Gurchot, *The John Beard Memorial Foundation, 1095 Market Street, San Francisco.*)

The recent paper by Blackwelder, Knight, and Sabrosky (*Science*, October 3, pp. 315–316) concerning proposals for clarifying Article 19 of the International Rules of Zoological Nomenclature deserves high merit, and it is to be hoped that the International Congress of Zoology—the only body with power to amend the Code—will pass favorably upon it when the group meets in Paris during July 1948. By way of introduction, the authors of the proposal write, "Obviously, each genus or species of animal can have only one valid name spelled in only one way . . . great confusion can result if each author is free to spell any name in the way that pleases him most."

With this in mind, I am prompted to write, because in the same issue of *Science* (p. 327) Seaman, in violation of the rules, refers to a species of *Paramecium* which he italicized as *Paramecium nucleatum* and which is presumably meant to be *Paramecium multimicronucleatum*.

The first to use the name *P. nucleatum* for this well-known, well-defined species was Mast (*Biol. Bull.*, 1947, 92, 31–72), who stated in a footnote, "The name "*multimicronucleatum*" is so long and unwieldy that the abbreviation, *nucleatum*, will hereafter be used in place of it" (italics his). *Paramecium nucleatum* is thereby used, in italics as a species name, in the remainder of his paper.

In view of the large amount of research that is being done now and that has been done in the past upon cultivation, cytology, serology, mating types, and conjugation, confusion is bound to be the result if two names are used for this well-defined species. It is to be hoped that its valid name, *Paramecium multimicronucleatum*, be retained and used in future publications. (Ralph Wichterman, *Biology Department, Temple University, Philadelphia.*)

R. W. Gerard's communication on the subject of the editing of scientific papers (*Science*, September 26, p. 289) reopens a perennial question which must be of interest to most readers of *Science*.

The problem rests, clearly, on the respective rights of editor and author. It can be solved very easily and correctly, I believe, by examining a little more closely than Prof. Gerard does the common basic assumptions regarding these respective rights. (What I have to say here concerns journal editing only; the editing of symposia and other collaborative works obviously involves a rather different set of problems.)

Editors, or their equivalents, are necessary evils, it must readily be granted by even the most disaffected. There must be liaison among a journal's publisher, authors, printer, and consumers; there are decisions regarding content and make-up that require an over-all control. But it is after this that, in my opinion and in Prof. Gerard's words, "the pendulum swings over."

Why should an editor be entitled to insist on a certain spelling, on particular abbreviations, and on a set form of literature-citation? Except for the last (where standardization, if it could be achieved, would benefit the indexers), I don't know. Do you?

Why should you, as author, and I, as editor, waste time haggling over what I conceive to be your errors of spelling, punctuation, and grammar? I don't know. Do you? Is it to mislead posterity, and your contemporaries who don't know you, into believing that you are more literate than you are? (Because it is your name only that they will connect with the paper.) Or is it to feed my ego by making you over as closely as possible into my literary image and likeness?

Why, if you are more literate than I and object to my attempt to bring you into line, should you be forced to submit your paper elsewhere when my journal is the one in which it properly belongs; when there is no other equally appropriate journal; or when, if there is, its editor is as autocratic as I am? I don't know. Do you?

It is the editor's right and responsibility, agreed, to say what papers and other material shall appear in his journal, to plan its make-up, and to facilitate its orderly production. Beyond that, four courses are open to him: (1) he may stop there; (2) he may insist upon certain literary uniformities; (3) he may insist only upon accuracy of statement and citation; (4) he may go whole hog and "vet" the manuscript.

Now, there are moral and historical aspects of this problem which might be thought to condition the editor's choice of these courses.

Anything printed becomes at once a potentially active contemporary force and a part of the historical record of the time. That being the case, the editor of a scientific journal would seem to have a strict responsibility (1) to serve the present by not publishing anything contrary to established fact; (2) to serve the present and posterity by presenting our authors faithfully in whatever state of literary grace each may have reached.

His selection of papers, the knowledge that they are factually reliable, his judgment in the matter of accessory material, his taste in the make-up of the journal, should obtain for the editor all the recognition he properly should seek. He is not, or should not be, a schoolmaster. A man old enough to write a scientific paper acceptable for publication on its scientific merits is a man old enough, one would think, to be permitted to express himself in his own way (or his secretary's), within the limits of space deemed suitable by the editor. If his way be literarily inept; if he have no literary conscience at all—so much the worse for him. Let him appear to his fellows and to posterity as he is. The ends of truth and progress are in no way furthered by "editing" him.

In short, I beg to suggest that, if editors were to drop the pedagogic mantle and confine their editing of typescripts to the correction of factual inaccuracies, the ends of science, progress, and history would be better served; and, as a little extra dividend, editors and authors might well become, as if by magic, the best of friends. (W. B. McDaniel, II, *librarian and editor, College of Physicians of Philadelphia.*)

TECHNICAL PAPERS

Effect of Tetraethyl Pyrophosphate on Sympathetic Ganglionic Activity

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This is a further report on the employment of anticholinesterases with reference to the nicotinic effect of ACh, dealing particularly with the most recently discovered antiesterase tetraethyl pyrophosphate (TEP). The nicotinic (ganglionic) effect of various doses of ACh was measured in terms of the pressor response in *atropinized* dogs treated with TEP. Ten γ of TEP/kg. of body weight was sufficient to elicit pressor responses with moderate doses of ACh (0.05–0.10 mg./kg.). With progressively increasing doses of TEP, the pressor response to two standard doses of ACh (0.125 and 0.25 mg./kg.) could be measured, and a curve relating TEP concentrations with the magnitude of the pressor response could be drawn.[1]

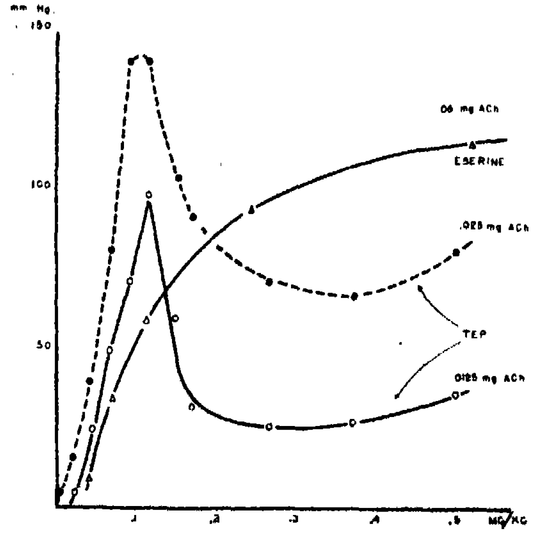

FIG. 1. Pressor response in atropinised dogs to acetylcholine after administration of increasing concentrations of TEP and eserine. (Abscissa—concentrations of the antiesterase in mg./kg.; ordinate—pressor response in mm. of Hg of blood pressure.)

This curve shows two peaks (Figs. 1 and 2), one following the sharp increase in pressor response when from 0.01 to 0.1 mg./kg. of TEP was administered, and another corresponding to the total amount of TEP of 15 mg./kg. A dip of pressor response with a minimum value (varying for individual dogs) for the total concentration of TEP of about 0.25 mg./kg. separates the two peaks. The second peak exceeded the first by some 20–33 mm. of Hg. Continued administration of TEP resulted in diminution of pressor response of ACh until none could be elicited at TEP levels of about 70 mg./kg. Under favorable conditions atropinized dogs survived with as much as 140 mg./kg. Thus, TEP proved to be a more powerful antiesterase than any previously reported. The initial maximal pressor response to ACh appears at the following levels: DFP, 15–20 mg./kg.; eserine, 0.5 mg./kg.; hexaethyltetraphosphate (HETP), 0.5 mg./kg.; and TEP, 0.1 mg./kg. (*5, 7*; see also Table 1).

It has been postulated in a previous communication (*7*) that the measurements of the pressor responses to standard doses of ACh in the presence of varying concentrations of different anticholinesterases could be used as an *in vivo* estimate of the inactivation of the cholinesterase. The present study of TEP further substantiates this assumption. Table 1 compares the estimated concentrations of the different antiesterases necessary to inactivate 50 per cent of the cholinesterase *in vivo* with the results obtained *in vitro* by several investigators. Since the latter experimented on animals other than the dog, only a general agreement can be expected. On the whole, the inhibition of the cholinesterase is obtained *in vivo* with smaller concentrations of the antiesterases; thus, the method presented here seems to be more sensitive than the *in vitro* method. At the first peak of the pressor response, representing approximately 100 per cent inactivation point of esterase, TEP seems to be

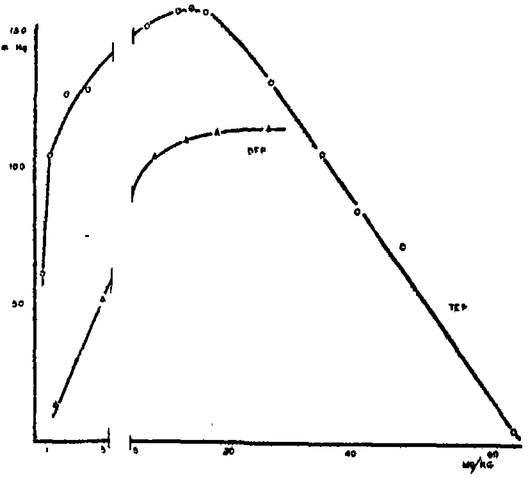

FIG. 2. Pressor response in atropinized dogs to acetylcholine after administration of increasing concentrations of TEP and DFP. Test dosages of acetylcholine: 0.0125 mg./kg. for TEP; and 0.05 mg./kg. for DFP. (Abscissa—concentrations of the antiesterase in mg./kg. Effect of the lower concentrations is not apparent on this scale (cf. Fig. 1); ordinate—pressor response in mm. of Hg of blood pressure.)

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[1] All drugs were administered in these experiments by injection into the femoral vein. Artificial respiration had to be given to dogs that received more than 1 mg./kg. of TEP.

from two to three times as potent as eserine and HETP and many times as potent as DFP. However, since the early parts of the inactivation curves of cholinesterase by specific antiesterases are steep and differ in character (unpublished results), the comparative estimate of the potency of the antiesterases may differ, depending on whether the 50 or 100 per cent inactivation point is taken as the index of activity. (See Table 1, specifically with reference to HETP and eserine.)

TABLE 1

SENSITIVITY OF ACETYLCHOLINESTERASE TO VARIOUS ANTIESTERASES

	DFP	HETP	Eserine	TEP
	Molar concentrations of inhibitor required to produce a 50 per cent inhibition of cholinesterase activity			
Roach cord (*1*)	3.0×10^{-6}	4.0×10^{-8}	1.0×10^{-8}	—
Human serum (*6*)	5.0×10^{-7}	—	5.0×10^{-6}	—
Horse serum (*6*)	1.3×10^{-8}	—	—	—
Cockroach serum (*3*)	—	1.0×10^{-7}	—	—
Rat brain (*3*)	6.3×10^{-6}	1.6×10^{-8}	—	—
Dog (*4, 5, 7*)	5.0×10^{-9}	4.0×10^{-10}	9.5×10^{-11}	8.5×10^{-11}
	Molar concentrations of the inhibitor required to produce a 100 per cent inhibition of cholinesterase activity			
Rat serum (*3*)	—	2.0×10^{-8}	—	—
Dog (*4, 5, 7*)	7.5×10^{-8}	1.0×10^{-9}	7.9×10^{-10}	3.3×10^{-10}

The efficiency of TEP seems to be especially remarkable, since in the presence of a wide range of its concentrations as small a dose of ACh as 0.8γ/kg. is sufficient to elicit pressor responses. This figure compares favorably with that of Dale (*2*) of 2γ for the minimum amount of ACh necessary to stimulate on close intra-arterial injection the striated muscle of the frog, and with the minimal amounts previously estimated to be necessary to produce sympathetic ganglionic effects.

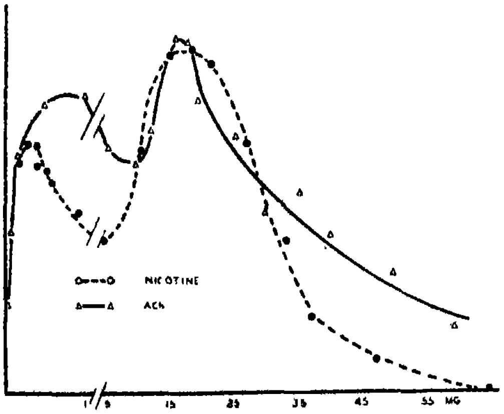

FIG. 3. Pressor response (ganglionic effect) in atropinized dogs to nicotine (0.1 mg./kg.) and acetylcholine (0.05 mg./kg.) (Abscissa—concentrations of eserine in mg./kg.; ordinate—pressor response in mm. of Hg of blood pressure.)

The second peak of the pressor response of ACh (Fig. 2), which occurs at considerable levels of TEP ranging from 15 to 20 mg./kg., is of particular interest. A similar peak occurs when the antiesterase used is eserine (Fig. 3; unpublished results). Also, the pressor effects of nicotine itself followed a double-peak curve with increasing amounts of eserine (Fig. 3). It is therefore tentatively suggested that the biphasic response to ACh elicited within a wide range of concentrations of different antiesterases is due to the effect of the latter on the sympathetic ganglia. The ganglia seem to be first depressed, and then, with higher concentrations of the antiesterases, rendered more responsive. Further research must determine whether this effect of the antiesterases on the ganglia is a direct one or related to the mechanism of the synaptic transmission.

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The Influence of Heredity on the Carotene Content of Corn[1]

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The extensive use of hybrid corn in recent years has emphasized the question of possible relationships between the heredity and nutritive content of corn and the possibility of producing hybrids of superior nutritive value. The early work of Hauge and Trost (*2*) pointed out that ordinary genetic factors controlled the vitamin A activity of dent corn, the genes responsible being the same as those governing development of the yellow endosperm. Recently Doty and associates (*1*) have reported that there is some indication that the amounts of the various amino acids in corn protein are related to the genetic constitution of corn hybrids, and that the physicochemical nature of the protein in the grain from two single cross hybrids was distinctly different. In general, however, information is lacking relative to the influence of the genetic constitution of corn on the nutritive value of the grain.

In the course of a comprehensive investigation dealing with this subject, crude carotene values were determined on the grain from all possible single cross combinations of 10 inbred lines of yellow dent corn, all of the same general maturity class and grown during the 1946 season. A 7 x 7 triple lattice design was used in the field experiment, thus providing for analysis three replicate samples of grain for each single cross. The field experiment was conducted near Chambersburg, Pennsylvania, the soil type and fertilizer treatment being the same on the three plots.

The corn was harvested at maturity, and the shelled corn was air-dried at room temperature for 10 days and stored in

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[1] This investigation was supported by a grant from the Pennsylvania Farm Supply Cooperatives.

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air-tight containers at 0°C. until it was analyzed. Carotene estimations were made by the official A. O. A. C. method (*3*), modified by the use of Hyflo Supercel and magnesium oxide, 3:1, as the chromatographic adsorbent.

Seed was not available for the Iowa I205 x Ohio 28 cross; hence, the carotene value for this combination is missing from the data. The range of yields of the other single cross combinations tested was from 71 to 123 bushels/acre.

The average difference between the highest and lowest of the three carotene values for the individual single crosses was of the order of 17 per cent, the values given in Table 1 being the means for three duplicate estimations. These data show that there are striking significant differences between the carotene contents of some of the inbred lines, irrespective of the lines with which they were crossed. On the average, combination of Nebraska 6 and Wisconsin 8 with other inbreds produced corn with the highest carotene content, while all crosses employing Iowa I205 were relatively low. The combination of Nebraska 6 with Wisconsin 8 produced corn with the highest carotene value of all the crosses.

TABLE 1

CAROTENE CONTENT OF CORN

(mg./lb.—15.5 per cent moisture basis)

	Nebraska 6	Wisconsin 8	Illinois M14	Illinois A	Indiana WF9	Ohio 28	Wisconsin 32	Ohio 51A	Wisconsin 22	Iowa I205
Nebraska 6		1.91	1.64	1.50	1.41	1.30	1.48	1.09	1.08	.67
Wisconsin 8	1.91		1.68	1.27	1.27	1.17	1.31	1.01	.88	1.07
Illinois M14	1.64	1.68		1.26	1.23	1.03	.93	1.17	.84	.70
Illinois A	1.50	1.27	1.26		.97	.95	.95	.93	.79	.66
Indiana WF9	1.41	1.27	1.23	.97		.93	.98	.79	.74	.62
Ohio 28	1.30	1.17	1.03	.95	.93		.88	.66	.72	—
Wisconsin 32	1.48	1.31	.93	.95	.98	.88		.79	.73	.58
Ohio 51A	1.09	1.01	1.17	.93	.79	.66	.79		.60	.53
Wisconsin 22	1.08	.88	.84	.79	.74	.72	.73	.60		.69
Iowa I205	.67	1.07	.70	.66	.62	—	.58	.53	.69	
Inbred line averages	1.34	1.29	1.16	1.03	.99	.96	.96	.84	.79	.69

Least significant difference between single crosses = .19 mg.

The superior value of yellow corn over white corn as a source of carotene has been recognized for many years. However, little attention has been paid to the fact that different strains of yellow corn may vary greatly in carotene content among themselves. The results presented here show that the genetic constitution of corn may be responsible, in large part, for its content of carotene, and that, all other conditions being the same, different strains of yellow corn may vary widely in carotene content. The results suggest further that, in the development of new corn hybrids, attention should be given to the content of important nutritive factors, among which carotene is but one. Further work along this line is now in progress.

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Enhancement of Penicillin Blood Levels Following Oral Administration of Caronamide

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Daily dosages of 5,000,000–40,000,000 units of penicillin were required with or without enhancing agents in treatment of the last 15 patients of a consecutive series of 150 cases of subacute bacterial endocarditis infected with nonhemolytic streptococci, including the resistant *Streptococcus* s.b.e. (*6, 9*). The penicillin was administered by continuous venoclysis for a span of at least 8 weeks, which was made possible technically by the conjoint use of heparin in the treatment program. These 15 patients, most of whom were treatment failures with penicillin per se before being admitted to our Clinic, received a total of 66,000,000–4,000,000,000 units of penicillin, the average being 630,000,000. At times streptomycin was also included in the treatment program. Of these 15 refractory patients, 3 (20 per cent) were unequivocal treatment failures despite these massive dosages, and 12 (80 per cent) were salvaged and considered cured by all clinical and laboratory criteria.

Early in our experience with this type of patient, it was found necessary to resort to agents for enhancing penicillin blood levels, primarily to obtain therapeutic values and also to conserve limited supplies of penicillin. In our studies in connection with the treatment of a case of subacute bacterial endocarditis infected with *Veillonella gazogenes* (*10*), curative levels of penicillin were obtained only by means of incorporating in the treatment program large amounts of PAH (sodium p-aminohippurate), as originally suggested by Beyer, Flippin, Verwey, and Woodward (*2*). Additional patients similarly treated were cured chiefly because of the penicillin-augmenting properties of PAH; the detailed data of these observations will be included in a forthcoming communication (*7*).

In conducting these studies with PAH it was soon evident that this agent, while extremely effective in augmenting penicillin levels by competing with the antibiotic for the tubular excretory apparatus, poses serious technical difficultues. It is ineffective when given by mouth and must necessarily be administered by vein in daily dosages of 200–240 grams. It has the additional disadvantages of unpleasant side-effects and a sclerosing effect on veins when given in the requisite concentration. As a result of all this, treatment cannot be continued uninterruptedly for any extended period.

Acknowledging the limitations imposed by intravenous administration and the necessity for large dosages of PAH, a new approach was sought by Beyer (*1*) which resulted in the development of the compound, caronamide (4′-carboxyphenylmethanesulfonanilide). Beyer found that the excretion of penicillin by a renal tubular transport mechanism could be physiologically inhibited reversibly. The basis for this effect is thought to be one of substrate competition between penicillin, which is excreted by the tubular, and caronamide, which is essentially refractory to excretion by that transport mechanism.

The purpose of this report is to present data indicating the capacity of orally administered caronamide to effectively enhance penicillin blood levels in a group of patients where excessively high levels are essential for cure. In these patients, infected with relatively insensitive organisms, enhancing agents are virtually indispensable for obtaining necessary amounts of the antibiotic in body fluids. A comparative study regarding the merits of various enhancing agents has been completed and will be the subject of a subsequent report (*8*).

Caronamide[1] was administered for 2–19 days to 9 patients (Table 1) with subacute bacterial endocarditis who were receiving conjoint intravenous penicillin-heparin therapy (*5, 11*). The caronamide was given orally in 2- or 3-gram dosages every 4 hours, day and night. To allow for adequate equilibration, the drug was administered at least 12 hours before blood samples were drawn for penicillin assay.[2] Following the coadministration of caronamide and penicillin, blood-level testing was done at various stages of the treatment period. For the most part, blood samples for penicillin assay were drawn an hour after the intake of a given dose of caronamide, when the influence of the compound is supposedly at its peak. The penicillin was given intravenously in the usual manner with heparin to facilitate free, uninterrupted flow of the antibiotic.[3] All the blood-level testing was done on blood samples drawn during rigidly controlled runs to insure the designated test dosage.

TABLE 1

PENICILLIN BLOOD LEVELS FOLLOWING COADMINISTRATION OF PENICILLIN AND CARONAMIDE IN 9 CASES OF SUBACUTE BACTERIAL ENDOCARDITIS

Case No.	Infecting organism	Daily dosage of penicillin i.v. (Oxford units times 1,000)	Oral caronamide		Penicillin blood levels (avg. Oxford units/ml.)			Urinary findings	Side-effects of caronamide
			Dosage (grams every 4 hrs.)	Total days administered	Control	After caronamide	Times enhanced		
(1) S. N.	*Streptococcus viridans*	5,000	2	2	3.75	4.00	0	Trace of albumen; occasional rbc and wbc.	
(2) E. S.	" s.b.e.	5,000	2	2	1.5	1.5	0	Occasional rbc and wbc.	Nausea
(3) A. H.	" s.b.c.	1,000	2	2	0.05	0.05	0	Trace of albumen and occasional rbc and wbc; reducing substance.	
		2,500	2	2	0.15	0.75	5		
		20,000	2	12	2.6	2.6	0		
		20,000	3	3	2.6	12.3	4+		
(4) H. K.	" *viridans*	5,000	2	2	13.75	60.0	4+	Trace to 3 plus albumen; wbc.	
		5,000	3	2	13.75	65.0	4+		
(5) I. B.	" s.b.e.	10,000	2	2	6.0	7.5	0	Reducing substance.	
		10,000	3	2	6.0	20.0	3+		
(6) H. B.	" s.b.e.	2,000	2	2	0.5	0.45	0	Trace of albumen; occasional rbc and wbc; reducing substance.	
		2,000	3	2	0.5	1.18	2+		
		5,000	3	2	4.12	30.0	7+		
		10,000	3	2	4.17	30.0	7+		
(7) A. L.	" s.b.e.	20,000	2	2	22.5	14.1	0	Occasional rbc and wbc; reducing substance.	
		20,000	3	5	22.8	66.5	3		
(8) A. B.		10,000	2	2	40.3	37.5	0	Trace of albumen; rbc; reducing substance.	
		10,000	3	5	40.3	86.9	2+		
(9) F. L.	" *viridans*	10,000	3	8	18.0	90.5	5	Trace of albumen; occasional rbc and wbc; reducing substance.	Nausea

Enhancement of penicillin blood levels was obtained in every instance where 3 grams was used every 4 hours. Eight of our patients had a mild degree of renal disturbance, which may or may not have had some bearing on the results obtained. In no instance did caronamide aggravate the pre-existing renal disorder. Accepting the dosage of 3 grams every 4 hours as standard, the minimum increase over control levels was twofold, and the maximum increase was seven fold. The total daily intravenous dose of penicillin, which ranged from 1,000,000 to 20,000,000 Oxford units, apparently had no influence on the degree of augmentation following caronamide administration.

The side-effects observed in these 9 patients were transitory and insignificant. Beyer and his group have reported 3 instances of the occurrence of a rash following the administration of caronamide (*3*). No cutaneous manifestations were encountered in our patients.

A reducing substance was discovered in the urine in practically every patient receiving 3 grams of caronamide every 4 hours. This disappeared from the urine shortly after the drug was discontinued and is presumably a metabolite product of caronamide (*3*).

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[1] The authors are indebted to the Medical Research Division, Sharp & Dohme, Inc., for the generous supplies of caronamide used in these studies.

[2] The penicillin assay method used was that of Rosenblatt, *et al.* (*15*), which employs *Str. pyogenes* C203 as test organism. In a comparative study this system was found by Dolkart, Dey, and Schwemlein (*4*) to yield generally and, at times, appreciably lower values than the F.D.A. assay procedure described by Randall, Price, and Welch (*13*), which uses *Bacillus subtilis* NRRL B-558 as the test organism.

[3] Supplied by Chas. Pfizer & Co., Inc.

It may be stated that there is now available an oral preparation which in suitable dosage consistently augments penicillin levels. The compound helps to conserve the consumption of penicillin where massive daily dosages are required, the economic implications of which are obvious. More important, some patients have difficulty in maintaining adequate blood levels despite intensive penicillin dosage. Ordinarily, following the administration of intravenous penicillin, it is not unreasonable to expect and obtain 0.1 Oxford unit/ml. of blood for every 100,000 units of penicillin administered (*12*, *14*). It is not always possible to maintain this ratio in a given patient. With the conjoint use of enhancing agents such as caronamide, not only can the expected blood values for a given intravenous dose of penicillin be obtained, but multiples of these anticipated values can, in point of fact, be achieved (Table 1, Case No. 6). This can mean the difference between success and failure in the treatment of the refractory case of subacute bacterial endocarditis.

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Experimental Determination of the Gyrofrequency

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The basic magneto-ionic theory of wave propagation in the ionosphere in the presence of the earth's magnetic field, as developed by Appleton (*1*) and by Appleton and Builder (*2*), was confirmed to an approximation in the lower latitudes some years ago. More recently extensive ionospheric observations in high latitudes have become available for the first time. Pronounced peculiarities in character of radio wave components returned at vertical incidence from the ionosphere in high latitudes have stimulated testing of the basic theory in terms of this new experimental information. For example, Scott and Davies (*4*) have described multiple magneto-ionic refraction of the wave energy into three or more components in a high geographic latitude. The three major components described by them indicate that both the longitudinal and transverse modes of wave propagation predicted by the theory occur simultaneously in certain high geomagnetic latitudes.

Through the courtesy of the College Geophysical Observatory, University of Alaska, some 800 selected ionospheric records from that station have been studied. In each record chosen it has been possible to determine independently the penetration frequency of wave components corresponding to: (a) the longitudinal ordinary ray, (b) the transverse ordinary ray, and (c) the extraordinary rays for both longitudinal and transverse modes of propagation. In addition, height of maximum electron density for the ionospheric layer under study has been determined.

The purpose of this note is to describe the experimental evidence, to review appropriate aspects of the magneto-ionic theory, and to discuss peculiarities disclosed in an attempt to reconcile theory and experiment.

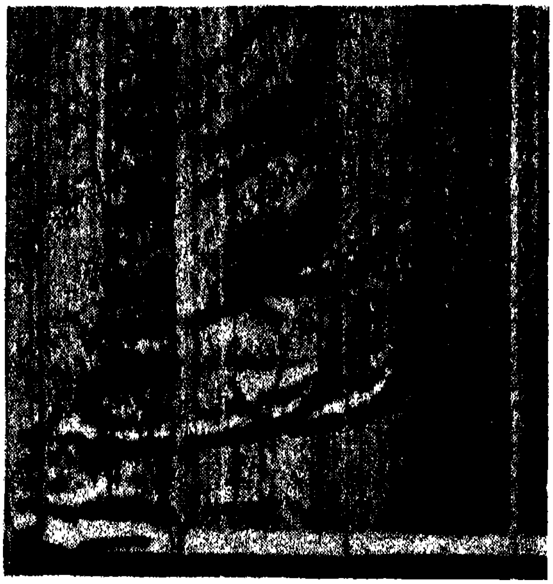

FIG. 1. Typical illustration of longitudinal and transverse modes of propagation occurring at the same time.

Consider Fig. 1, which is a typical ionospheric record taken at the University of Alaska. Ordinates are virtual height, increasing upward. Abscissas are wave frequency, increasing to the right. Penetration frequencies as noted in the figure are as follows: f_1, the longitudinal ordinary ray; f_2, the transverse ordinary ray; f_3, the extraordinary rays; and f_H, the calculated gyrofrequency for electrons in the earth's magnetic field. Experimentally, numerical values of f_1, f_2, and f_3 were determined from each record, as well as the height of maximum electron density, after the technique of Booker and Seaton (*3*).

The magneto ionic theory predicts, to a first approximation, that the relationship between wave components returned at vertical incidence from the ionosphere is as follows:

(a) For transverse mode of propagation—

$$(f_3 - f_2) = \frac{f_3 f_H}{(f_3 + f_2)} \tag{1}$$

(b) For longitudinal mode of propagation—

$$(f_3 - f_1) = f_H \tag{2}$$

The experimentally determined values were first examined in terms of the change in precession-frequency with height for transverse mode of propagation in the sporadic E-layer. Fig. 2 gives precession-frequency as a function of height. Each point of the diagram is the mean value of approximately 20 independent measurements. Clearly, the precession-frequency falls rapidly with increase in height, over the height range available experimentally.

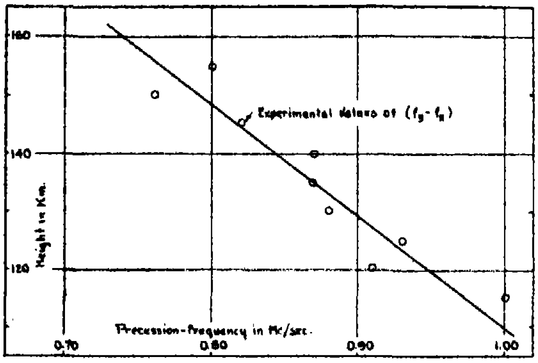

FIG. 2. Precession-frequency in the sporadic E-layer for transverse propagation, College, Alaska.

Next, values of f_H were calculated for the transverse mode of propagation from experimental values of f_x and f_y for the sporadic E-layer. In Fig. 3 these values of f_H are given as a function of height. The dotted line to the left in the figure is the theoretical value of gyrofrequency to be expected if the earth's magnetic field decreases inversely as the cube of the distance. Again, each point is the mean value of approximately 20 independent observations.

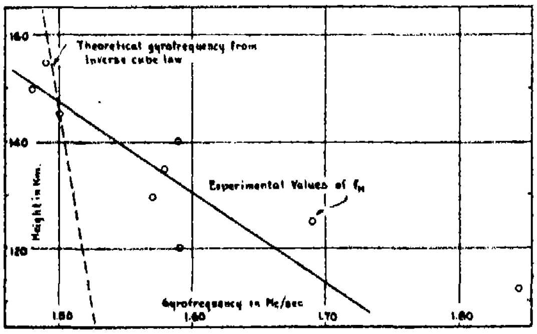

FIG 3. Experimental values of gyrofrequency determined in the sporadic E-layer for transverse propagation, College, Alaska.

Evidently over the range of height involved the experimental values of gyrofrequency do not agree with theoretically expected values. That the slopes of the experimental and theoretical curves do not coincide is interesting. Since the magneticians have suggested that variations in the earth's magnetic field may be explained on the basis of a sheet of current flowing in a region of the atmosphere below a height of 100 km., the question may well be raised as to whether or not the observed departures of experimental from calculated values of f_H may be the result of induced magnetic field from such a current flow.

In order to examine the relationship between calculated and experimentally determined values of gyrofrequency over a more extended height range, Fig. 4 is presented. Each point in the diagram is the mean value of approximately 40 independent determinations. Generally speaking, the agreement between values of f_H determined by means of the longitudinal mode of propagation and those found theoretically is quite good except over the height range in the vicinity of the E-layer. Upon the basis of such agreement it can be said that the magneto-ionic theory for longitudinal mode of propagation is substantially confirmed.

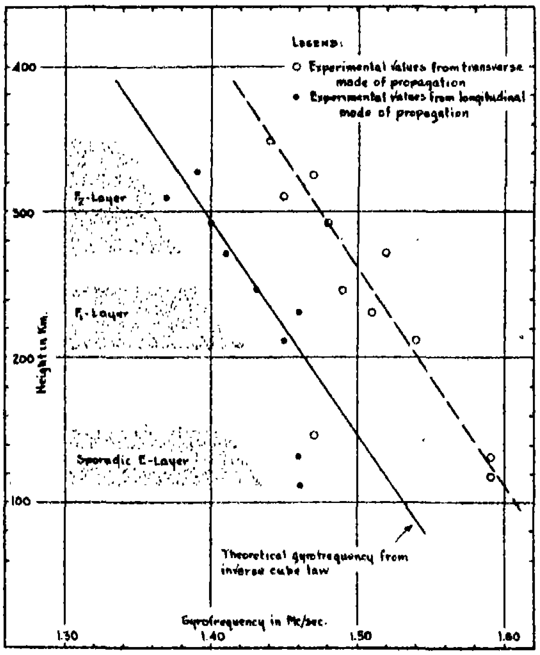

FIG. 4. Mean values of gyrofrequency determined experimentally at College, Alaska.

However, the experimental values of f_H determined from the transverse mode of propagation lie consistently to higher values by about 0.08 Mc/second. While this difference is small, it appears to be real. Just why this constant difference exists between values of f_H determined experimentally from longitudinal and transverse modes of propagation is not clear. Perhaps the simplifications employed by Appleton and by Appleton and Builder in interpretation of the theory are responsible for this lack of correspondence. Some differential effect, possibly associated with the treatment of collisional friction, may be responsible for the discrepancy. Until an adequate explanation is decided upon it cannot be said that the magneto-ionic theory is in agreement with experimental results in high geomagnetic latitudes for the transverse mode of propagation.

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IN THE LABORATORY

Conversion of Isotopically Enriched CO_2 to CO

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Current interest in the synthesis of organic compounds containing isotopic tracer atoms makes it desirable to convert carbon dioxide enriched in C^{13} or C^{14} into other useful compounds. A simple method of converting $C^{*}O_2$ to $C^{*}O$ would be useful in the synthesis of labeled methyl alcohol[1] and labeled sodium formate. A satisfactory method was found to be the reduction of CO_2 with hot zinc as used by the authors (*3*) in the concentration of CO_2 enriched in C^{13}. This method of concentrating C^{13} made use of the isotopic exchange reaction $C^{12}O + C^{13}O_2 \rightleftarrows C^{13}O + C^{12}O_2$ in conjunction with thermal diffusion which produced countercurrent flow of CO_2 and CO. The $C^{13}O_2$ produced by isotopic exchange at the hot wire is transported toward the bottom of the column, where it must be converted to $C^{13}O$ if total reflux is to be established. This conversion was accomplished by circulating the CO_2 through zinc powder at about 400° C. (*1*). It was found advantageous to support the zinc dust on asbestos fiber to give greater porosity and to prevent clogging. Small pellets about 6 mm. in diameter were made from a moistened mixture containing 95 per cent by weight zinc dust and 5 per cent asbestos fiber of the type used for Gooch crucibles. These were dried at 110° C. for 24 hours before being placed in the converter. Spectrographic examination of the zinc (technical grade) showed the presence of Pb, Cu, and Sn as impurities.

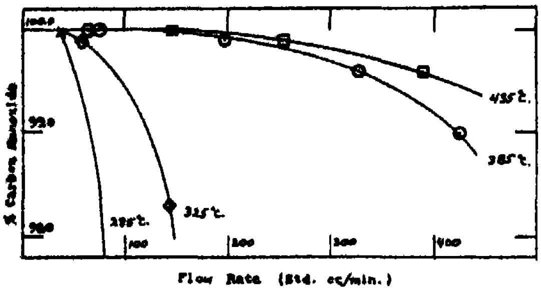

FIG. 1. Effect of flow rate and temperature on percentage conversion of CO_2 to CO.

In order to study the efficiency of conversion of CO_2 to CO under various conditions, 50 grams of the zinc pellets were placed in a 15-cm. length of Pyrex tubing 25 mm. in diameter. A Chromel-Alumel thermocouple was attached to the outside wall, and the converter was then placed in a furnace. Carbon dioxide at atmosphere pressure was passed through the converter at several rates of flow at each of the following temperatures: 435° C., 385° C., 325° C., and 285° C. The result are given in Fig. 1, in which the percentage conversion at each temperature is plotted against the flow rates.

An Orsat apparatus was used to measure the concentration of CO to ± 0.2 per cent. These results indicate that a yield of 99–100 per cent CO can be obtained at temperatures between 385° and 435° C. with flow rates as high as 400 cc./minute. Convenient operating conditions seem to be a temperature of 400° C. and a flow of about 100 cc./minute. This will assure a conversion of 99.5 per cent for a single passage through the converter. The CO_2 may be forced through the converter by means of pressure or drawn through with a Toepler pump arrangement. About 15 l. was converted for use in the chemical exchange column without any loss in efficiency of the converter

The available quantity of isotopically enriched CO_2 is frequently small; consequently, a method of converting smaller volumes of CO_2 is desirable. Suitable arrangements are illustrated in Fig. 2 (B, C) for use with conventional-type sample tubes. The apparatus shown in Fig. 2(A) was used to measure the efficiency of the converter when connected to a closed system in which the samples are frequently stored. The converter was attached in a vertical position to the two glass tubes leading into the 2-l. bulb which contained CO_2 at a pressure of about 80 cm. Hg.

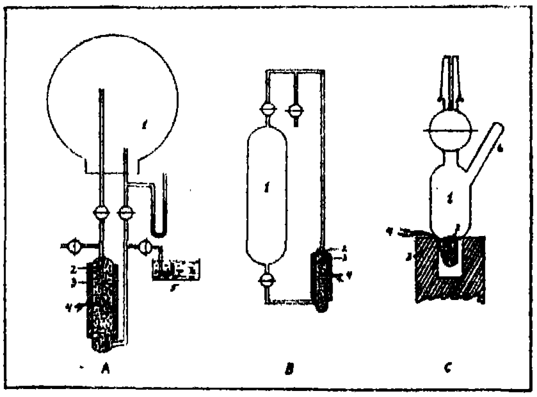

FIG. 2. Apparatus for conversion of isotopically enriched CO_2 to CO: (1) sample container; (2) zinc-asbestos mixture; (3) furnace; (4) thermocouple leads; (5) mercury trough for collecting samples; (6) inlet for introducing zinc-asbestos mixture

After evacuating the converter, the furnace was adjusted to the desired temperature and the stopcocks opened. Convection up through the converter acts to recirculate the gas from the bulb through the zinc pellets. Small samples (0.5 cc.) were withdrawn periodically and analyzed with a Blacet-Leighton microgas analysis apparatus (A. H. Thomas Company). Experiments at 425° and 480° C. (Fig. 3) showed that practically complete conversion was obtained in 5–6 hours. The fact that no significant change in total pressure occurred indicates that very little, if any, CO is lost by decomposition.

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[1] See, for example, the high-pressure synthesis of deuteromethyl alcohol from CO and D_2 by J. E. Zanetti (du Vigneaud, V., Chandler, J. P., Cohn, M., and Brown, G. B. *J. biol. Chem.*, 1940, 134, 787).

The solid curves represent the dependence of CO concentration on the time as obtained from the results of the following calculations. If x is the mole fraction of CO in a bulb (of volume V cc.) at a time t, then with a convective transport rate of T cc./minute upwards through the converter, the flow of CO_2 into the converter at time t is $T(1-x)$ cc./minute. Assuming complete conversion of the CO_2 in the mixture to CO, $T(1-x)$ also represents the increment in the flow of CO leaving the top of the converter at time t. The net increase in the number of cubic centimeters of CO in the vessel is then given by:

$$V\frac{dx}{dt} = T(1-x).$$

The solution of this equation for the boundary condition, $x = 0$ at $t = 0$, gives the following expression for the time dependence of the concentration of CO in the vessel:

$$x = 1-e^{-Tt/V}.$$

The two solid curves in Fig. 3 were obtained by substituting convective flow rates of T = 35 cc./minute and T = 40 cc./minute in the above equation. It is therefore evident that the convective flow in the converter was approximately 35–40 cc./minute. Using this value for T, the percentage conversion at any time, t, can be calculated. It can be seen that this method may readily be adapted to the determination of convective transports through different types of packed columns for engineering experiments.

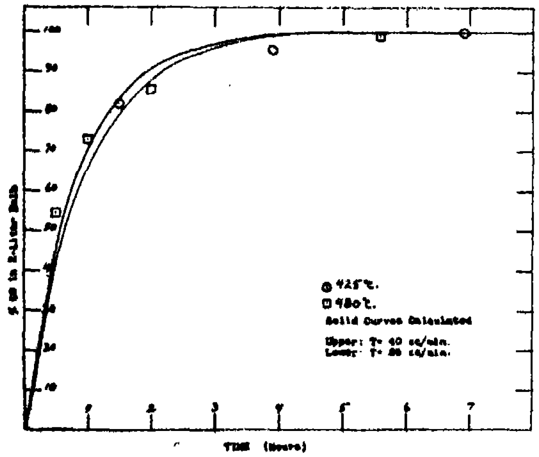

FIG. 3. Rate of conversion of CO_2 to CO in a closed system.

To test the method for conversion of small samples, a 5-cc. reaction vessel containing about 1 gram of the powdered zinc-asbestos mixture, as illustrated in Fig. 2(C), was used in connection with a standard system (*2*) for obtaining CO_2 from $BaCO_3$. Carbon dioxide was liberated from 40 mg. of $BaCO_3$,[2] in which a mass spectrographic analysis showed 3 per cent of the carbon atoms to be C^{13}. After the sample was transferred to the reaction vessel, the zinc was heated to about 425° C. for two hours. Analysis with the microgas analysis apparatus showed 99 per cent conversion to CO. Mass spectrographic analysis showed that it contained 3 per cent $C^{13}O$.[3] The carbon monoxide may be converted back to carbon dioxide, if desired, by passing it through copper oxide heated to 400° C.

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A Kinesimeter for Studying the Spontaneous Activity of Small Animals

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With the increase in number of sympathomimetic amines in use and under investigation for their circulatory effects, it has become necessary to study their effects on central stimulation with ever-increasing accuracy.

Many types of activity recorders have been employed for this purpose and with varying degrees of results.

As early as 1898, Stewert (*6*) tested the effects of alcohol, diet, and changes in barometric pressure on the spontaneous activity of small animals. His method consisted of a squirrel cage made of wire mesh 18 inches in diameter and 20 inches in length. The animal's movements caused the cage to rotate. An eccentric coupled to the escapement mechanism of an alarm clock caused the revolutions to be registered by the second hand. Slonaker (*5*), using a slight modification of the same technique, studied the normal activity of the white rat at different ages. His findings showed that the greatest activity of the rat occurred when the animal was 87–120 days old.

The above method, of course, is suitable only for the type of research in which activity is studied for many days or weeks. For studies of activity due to the central nervous excitability of various drugs, involving only a few hours, a much more sensitive apparatus had to be developed.

Schulte, *et al.* (*4*) used a cage and spring suspension, coupled to a work adder by a string. As the animal's motions moved the cage, the work adder revolved. A signal magnet recorded these motions on a kymograph. This method has a decided advantage in that it takes into account both large and small motions and accumulates them. However, the cage is undamped and is free to oscillate in any direction.[1]

Abreu (*1*) used a cage suspended by a spring in which the movements were transmitted by a tambour-air system to a kymograph.

The above types of apparatus are best described by the term "jiggle" cages. Since they are all suspended on coiled springs, one movement of the animal results in from one to several movements of the cage. Both vertical and pendular movements may be transmitted to the recording devices.

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[2] The authors are indebted to Dr. A. V. Grosse of the Houdry Process Corporation for the barium carbonate enriched in C^{13}.

[3] Thanks are due to E. H. Mosbach for assistance with the mass spectrographic and gas analyses and to Miss M. Lamson for help with the spectrographic analyses.

[1] C. W. Geiter, of Frederick Stearns & Company, developed a method whereby a cage was suspended on a spring. As the animal's motions caused the cage to move up and down, a flag cut a beam of light, causing a photocell to operate a counter (unpublished).

Ross E. Hart, of Jefferson Medical School, Philadelphia, studied activity by means of transmitting the motions of an activity cage coupled to an air tambour writing on a kymograph. By this method activity can be judged roughly by inspection of the records (unpublished).

These types of apparatus serve very well for screening work, but for more accurate work a type in which the spring is damped sufficiently to eliminate the "jiggle" is required. It is also desirable to eliminate any pendular movements which might record.

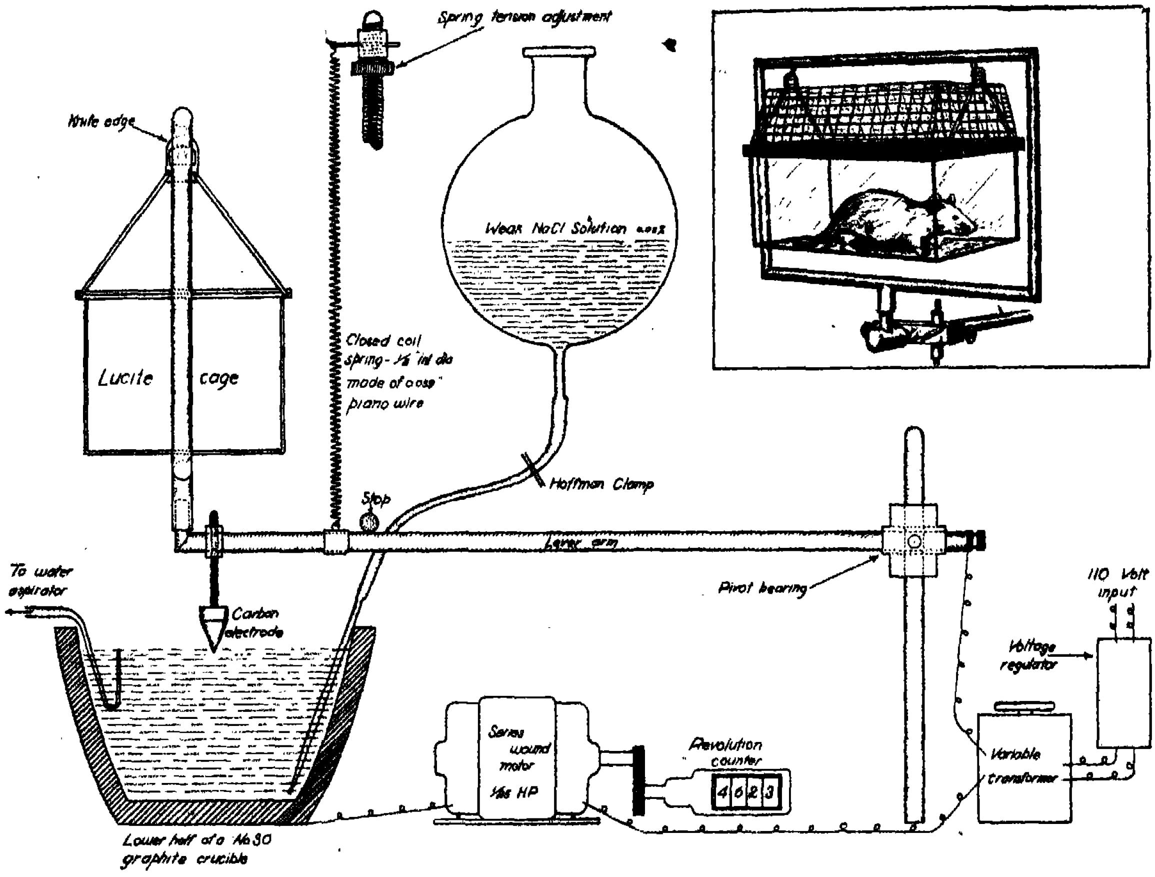

FIG. 1. Semidiagrammatic drawing of kinesimeter. Cage suspension is shown in insert.

The apparatus herein described (Fig. 1) consists of a Lucite cage. The advantages of Lucite are its lightness in weight and its rigidity, which imparts the full force of the animal's motions to the upper electrode. The closed bottom of the cage keeps the animal's urine from getting into the electrolyte solution. The lid is made of ¼-inch mesh screen wire in the form of an inverted box, so that the animal's movements are completely unhampered. The cage is suspended on knife edges mounted rigidly to one end of a horizontal brass tube 20 inches long. The other end of this tube is attached to an upright by pivot bearings. It is very important that the cage be suspended on knife edges, since direct attachment of the cage to the horizontal lever arm changes the arm's length as the rat shifts its position from side to side. If the rat went to sleep on the side of the cage distal to the pivot of the horizontal arm, the motor would turn and thus faultily register activity. The whole assembly is suspended on a damped coiled spring. Directly under the plastic cage is mounted a pointed carbon electrode. This upper electrode dips into a weak solution of sodium chloride (.08 per cent) contained in a No. 30 graphite crucible resting upon a sheet of metal which forms another (lower) electrode. By this means a variable resistance is formed which is connected in series with a series wound fractional horsepower motor. A speed reducer of variable ratio at the end of the motor drives a revolution counter. This assembly is supported by a ⅜-inch coiled spring, the tension of which may be varied according to the weight of the rat.

The upper electrode is so mounted that its height can be adjusted independently of the rest of the apparatus and so regulated that it barely makes contact with the salt water. The current is decreased by a variable transformer or rheostat until the motor armature just ceases turning. This causes the motor as well as the spring to be heavily damped.

The slightest movement of the animal which results in a downward thrust will push the pointed (upper) electrode downward in the salt water, which in turn decreases resistance in the circuit and causes the motor armature to turn. Due to the conical shape of the electrode, the further it is thrust into the salt water, the faster the motor will revolve. Since the spring supporting the apparatus follows Hooke's law, the slope of the electrodes can be adjusted to cancel, or at least minimize, the effect of the spring. Thus, the counter registers only the downward thrust of the rat.

The instrument can easily be made self-recording. The revolution counter is removed, and the speed reducer shaft is extended several inches. At the end of the shaft is mounted a 2-inch writing point which describes arcs on a slowly moving kymograph. A 15-minute-interval time signal is included with the assembly.

In our studies only male white rats were used, thus eliminating any behavior which might be due to various phases of the oestrus cycle of the female. The animal is first placed in the cage, and the apparatus is adjusted to its weight. It is then removed and injected with the solution under investigation. Twenty-eight animals injected with normal saline were used as controls. The amount of saline injected was made to correspond with the volume of the drug injected. As soon as the injected animal was placed in the cage the initial reading was taken. Subsequent readings were taken at 15-minute intervals the increments between readings being recorded and plotted on graph paper.

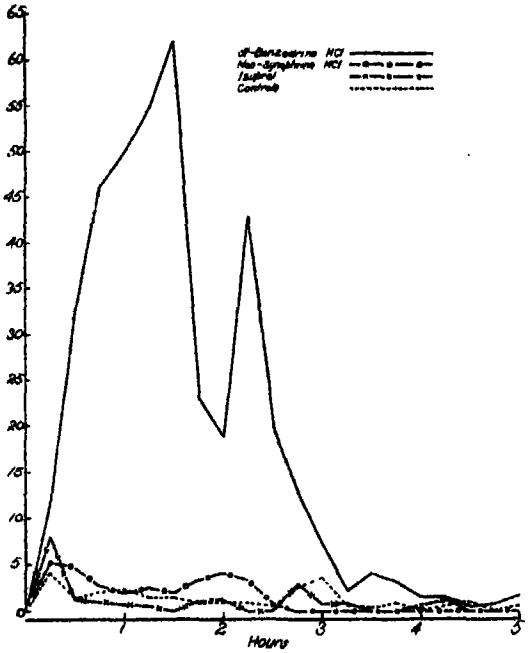

FIG. 2. The effect of dl-benzedrine hydrochloride, Neosynephrine hydrochloride, and Isuprel upon the spontaneous activity of albino rats

The number of rats and the dosage used in the case of each compound tested were as follows:

	No. of rats	Dosage (mg./kg.)
dl-Bensedrine HCl	6	5.0
Neosynephrine HCl	6	1.75
1(3′,4′-Dihydroxyphenyl)-2-isopropylamino-ethanol HCl (Isuprel)	6	1.0
N-Methyl-β-cyclohexylisopropylamine HCl		
d-isomer	9	20.0
d-isomer	12	5.0
l-isomer	15	5.0

The results of the tests with the first three compounds, (Fig. 2) which are in agreement with other workers in the field, clearly show that dl-bensedrine hydrochloride is extremely exciting to the central nervous system, whereas Neosynephrine hydrochloride and Isuprel show no appreciable stimulating properties.

Both of the two other compounds studied, l-N-methyl-β-cyclohexylisopropylamine hydrochloride and d-N-methyl-β-cyclohexylisopropylamine hydrochloride, showed only a small amount of stimulation of the central nervous system. The d-isomer exhibited about twice the stimulating effect of the l-isomer. This is not in agreement with the results obtained by Frick and Becker, as reported by Lands, *et al.* (*3*). These investigators found the l-isomer somewhat more stimulating than the d-isomer. However, the writer's findings are in substantial agreement with that of Fellows and his workers, whose preliminary results show that 5 mg./kg. of the l-isomer induces less activity than 20 mg./kg. of the d-isomer (*2*).

Since the two isomers had not been given in comparable doses, it was thought advisable to do so. Accordingly, attempts were made to inject 20 mg./kg. of the l-isomer. The animals showed evidence of toxicity, and no activity resulted. The d-isomer was then injected at a dose level of 5 mg./kg., and the animals responded immediately with increased activity. These results are shown in Fig. 3.

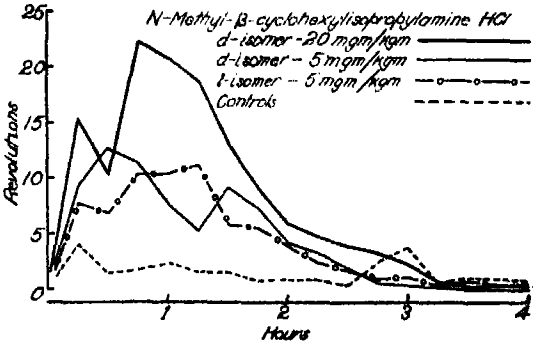

FIG. 3. The effect of d- and l-isomers of N-methyl-β-cyclohexylisopropylamine hydrochloride on the spontaneous activity of albino rats.

The theoretically ideal kinesimeter would be one which records the motions of an animal directly and does not depend upon any moving parts for its operation. Thus, errors caused by pendular movements and "jiggle" of the machine would be eliminated. This recorder should be extremely sensitive to all movements of the animal's body, including small motions of the head. The apparatus, in addition, should integrate these small movements with large body movements. It would also be desirable if the machine would record in absolute units such as gram-centimeters of work per unit of time, instead of revolutions of a wheel, the pumping of a quantity of water, or the turning of a motor armature.

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Book Reviews

Low-pressure laminating of plastics. J. S. Hicks. New York: Reinhold, 1947. Pp. 162. (Illustrated.) $4.50.

In the words of the author, "The very young field of low-pressure laminating and fabricating has set forth in its swaddling clothes after V-J Day to seek its proper place. . . . ." The technical usefulness of these relatively new resins and processes is a challenge to plastic fabricators. This book, therefore, should be very helpful to those who want to become acquainted with this field. The low-pressure laminating techniques are explained in very elementary fashion with many pictures to illustrate the various steps.

The author has limited his discussions strictly to the low-pressure techniques and has carefully refrained from padding the book with information on the many related subjects. Lists of books and pertinent references can be found throughout the text; also, the names of some of the suppliers of laminating equipment and materials are given.

The final chapter on engineering and cost principles contains interesting tables showing the comparative weight and cost per cubic foot of the various types of structural materials, and a list of 11 experiments, giving detailed instructions for making and fabricating simple laminations, appears in the appendix.

Although the information in the book is reliable and instructive, it is designed primarily for the beginner. The expert might find it disappointing for that reason.

J. M. GRIM

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Concise anatomy. Linden F. Edwards. Philadelphia: Blakiston, 1947. Pp. xxiv + 548. (Illustrated.)

This book represents the second edition of a text first published in 1934 under the title *Anatomy for physical education*. The present edition has been written for the student in the various ancillary fields of anatomy, such as physical therapy, nursing, etc., and is not intended as a substitute for the more comprehensive treatises used by medical and dental students. Regional anatomy is emphasized rather than systemic, although several chapters are devoted to the major systems. The text is, on the whole, clear and well written. The illustrations are adequate, but few are original; 225 of the 324 total are taken from Morris' *Human anatomy* alone. The physical aspect of the book and the arrangement of the printed page is clear and pleasing.

Evaluation of the over-all worth of a new textbook of anatomy is difficult. So many have been written, and for so many purposes. Errors or differences in interpretation can be found in all of them, the large as well as the small. The basic material is comparatively well standardized, and the chief discrepancy of opinion invariably lies in the amount of descriptive detail deemed necessary for the purpose. A certain class in physical therapy once taught by the reviewer would have been swamped by the detail in *Concise anatomy*; in the hands of Prof. Edwards they might have thrived upon it. The average medical student, in these turbulent days of "down with nonessentials," would be apotheosized if he knew half of Prof. Edwards' book, but no professor of anatomy will ever be willing to admit this. These are the facts and individual opinion remains largely just that.

JEAN PIATT

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Advanced mathematics for engineers. (2nd ed.) H. W. Reddick and F. H. Miller. New York: John Wiley; London: Chapman & Hall, 194. Pp. xii + 5087. (Illustrated.) $5.00.

This book, written by two professors at Cooper Union Institute of Technology in New York, is the result of lectures for juniors and seniors in engineering courses at this Institute. The first edition was published in 1938. This second edition shows that the efforts of the authors have met with the appreciation of their colleagues.

The 11 chapters deal with ordinary differential equations, hyperbolic functions, elliptic integrals, infinite series, Fourier series, Gamma and Bessel functions, partial derivatives and partial differential equations, vector analysis, probability, functions of complex variables, and the operational calculus. This constitutes a considerable amount of material, and it is treated very well. A large number of problems, the answers to which are given in the last pages of the book, enrich the text.

Some interesting applications enliven the theory. Examples of the use of hyperbolic functions are Schiele's pivot and the buckling of a rotating shaft; elliptic functions are illustrated by the skipping rope and the field intensity due to a circular current. The problem of a wire clamped at its lower end at a small angle with the vertical serves as a case which leads to Bessel functions. As applications of partial differential equations of the second order we meet the determination of the resultant magnetic field strength arising from a current excited in a solenoid and the induced eddy currents set up in the copper core, as well as a problem of the drying of a porous slab by evaporation. The chapter on the operational calculus includes not only the Heaviside operators, but also Bromwich' line integrals.

The second edition differs from the first mainly by an appendix of 5 pages on "Units and Dimensional Analysis," a considerable extension of the number of problems, and the addition of a few new topics. The authors mention specifically among these new problems a mechanical brake problem involving elliptic integrals (based on an article by I. Opatowksi. *Amer. math. Monthly*, 1941, p. 443), a more extended treatment of Fourier series, and an article on the vibrating membrane in a rigid rectangular frame.

This reviewer is very well pleased with the authors' clear way of exposition; it is a pleasure to read this book. It can be strongly recommended to students of engineering and physics who are in need of advanced calculus either as their main text or as supplementary reading. It ranks with the best books on this subject in any language.

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Biosynthesis of Penicillins

The Editorial Board of the Monograph on the Chemistry of Penicillin

THIS BRIEF SUMMARY IS A PRELIMinary notice of findings secured up to the end of 1945 in a collaborative effort of a large number of American and British investigators working under the auspices of the Office of Scientific Research and Development and the Medical Research Council. Full details will be published in the forthcoming penicillin monograph, together with an account of experiments not referred to in this report.

In the consideration of methods for increasing the fermentative production of penicillin, it appeared that the yields might be limited by the inability of the mold to produce adequate amounts of essential intermediates. Studies of the biochemistry of penicillin formation were undertaken in several laboratories to determine whether products from the chemical degradation of penicillin, possible metabolic intermediates, or other similar substances might be capable of stimulating the production of penicillin. These studies have been successful; by the addition of certain precursors to the fermentative media the yield of penicillin has been substantially increased. The method has also been found to be applicable to the synthesis of new penicillins, several of which have been obtained in yields representing as much as 60–100 per cent of the total penicillin formed. A number have been isolated in pure crystalline form.

Studies carried out in the Northern Regional Research Laboratories (*5*) indicated stimulation of penicillin production in surface cultures by phenylacetic acid. Attempts to demonstrate an influence on the type of penicillin produced were not successful. The effect on submerged cultures was questionable, and the work was carried no further in the Peoria laboratory.

Independently, investigators in the Glaxo Laboratories (*17*) undertook experiments with the express intention of studying the biosynthesis of penicillin. The stimulus for this effort was provided by a report from Imperial Chemical Industries (*3*) that two different strains of ***Penicillium notatum*** produced principally benzylpenicillin on a corn-steep medium, but principally 2-pentenylpenicillin on a synthetic medium. It was found that a constituent of corn-steep protein, phenylalanine, in 0.25–1 per cent concentration, or a number of deamination or decarboxylation products of phenylalanine in smaller concentrations, stimulated penicillin production in surface cultures. By means of chromatographic separations, the production of benzylpenicillin in a synthetic medium in the presence of phenylacetamide by ***P. notatum*** was demonstrated under cultural conditions which, without the adjuvant, had previously given no indication of producing any highly active principle other than 2-pentenylpenicillin (*4*).

TABLE 1

REPRESENTATIVE COMPOUNDS EFFECTIVE AS BENZYLPENICILLIN PRECURSORS*

	Stimulation	Concentration (mg. %)	Reported by
DL-Phenylalanine	1.82	250	Glaxo (*17*)
Phenylacetic acid	+	10	" (*17*)
	–	11	Lilly (*7*)
Phenylacetamide	2.0	100	Glaxo (*17*)
β-Phenylethylamine	2.0	50	" (*17*)
N-Phenylacetyl-DL-valine	1.64	20	Lilly (*8*)
N-(2-Hydroxyethyl)-phenylacetamide	1.57	14	" (*10*)
N-(2-Aminoethyl)-phenyl acetamide	1.56	14	" (*9*)
2-Aminoethyl phenylacetate (hydrochloride)	1.26	17	" (*11*)
N-Allylphenylacetamide	1.48	14	" (*13*)
N-Methylphenylacetamide	1.04–1.73	10	Cutter (*6*)
	1.53–1.83	25	Heyden (*16*)
N-Hydroxymethylphenylacetamide	1.55	10	Abbott (*1*)
N-(2-Hydroxyethyl)-γ-phenylbutyramide	1.35	16	Lilly (*12*)
δ-Phenylbutylamine (sulfate)	1.39–1.54	13–25	Heyden (*16*)

* "–" indicates no stimulation in yield; "+" indicates positive stimulation; the numbers under "Stimulation" represent the ratio: units in test container/units in control container.

Among the American workers, the Upjohn Company (*18*) had reported testing the effects of several compounds, and the Lilly Research Laboratories (*7*) had initiated extensive studies on precursors. The Lilly studies led to the discovery of several groups of phenylacetyl derivatives that were effective in increasing penicillin yields—in this case, with submerged cultures. Table 1 lists a number of representative compounds found effective in the various laboratories. Considerable specificity was evident in the ability of the molds to utilize compounds. Although N-phenylacetyl-L-valine was an effective precursor, N-phenylacetyl-D-valine did not serve as a stimulant. Mixtures of phenylacetic acid and DL-valine or phenaceturic acid and acetyl-DL-valine were ineffective. The group of phenylacetylated amino acids that proved to be stimulatory was found to be limited.

It is of interest that the response of different strains to specific compounds varies. It has already been pointed

The monograph entitled *The chemistry of penicillin*, now in preparation under the supervision of the National Academy of Sciences and the Office of Scientific Research and Development, is to be published by the Princeton University Press.

out that certain submerged-culture strains did not utilize phenylacetic acid. It is now recognized that the more recently discovered strains, Q-176 and X1612, respond to the addition of this compound.

It is obvious that an increase in the yield of a biological product upon addition of a given substance to a medium may be caused through other mechanisms than that of precursor action. For example, a stimulation of production may be due to utilization of a compound either as a vitamin or growth promoter, as a building block to be incorporated into mycelial growth, or to satisfy any one of several other types of metabolic requirements. To ascertain whether the stimulation in penicillin production was due to a direct utilization of the precursor, the Lilly workers suggested (*8*) that deuteriophenylacetyl-DL-N^{15}-valine[1] be added to a culture medium. By means of the deuterium analysis it was shown that 92.5 per cent of the resulting penicillin was derived from the precursor. In sharp contrast, the N^{15} content was only 2.6 per cent of the value expected if the phenylacetylvaline had been utilized intact. Although it is apparent that the phenylacetyl moiety appeared in the penicillin, the role of the amide portion of the molecule remains undefined. N^{15}-Phenylethylamine was also used as a precursor (*2*). There was a significant quantity of N^{15} in the penicillin produced, as judged from the penillic acid isolated from it. The quantity of N^{15} introduced was small, representing only 1.65 per cent of the amount that could have been introduced if the nitrogen of the phenylethylamine were the sole source of one of the nitrogen atoms in the resulting penillic acid.

In contrast to the effective incorporation of benzylpenicillin precursors, no unequivocal utilization of precursors for the natural aliphatic penicillins has been demonstrated.

Arnstein, Catch, Cook, and Heilbron (*2*) used *p*-hydroxyphenylacetic acid in surface cultures. Although there was no increase in absolute yield, they were able to demonstrate that in place of the usual small proportion (about 5 per cent) of *p*-hydroxybenzylpenicillin, approximately 35 per cent of this penicillin was produced in the presence of 0.05 per cent of *p*-hydroxyphenylacetic acid. The Lilly group presented evidence of the production of this penicillin by the use of N-(2-hydroxyethyl)-*p*-hydroxyphenylacetamide in submerged cultures. In lots prepared without precursor, no *p*-hydroxybenzylpenicillin was demonstrable. However, with the use of 0.025 per cent of the compound, an appreciable penicillin fraction was found which had solubility characteristics and a differential assay value comparable to authentic *p*-hydroxybenzylpenicillin. These results clearly offered the opportunity of controlling the production of *p*-hydroxybenzylpenicillin.

The Lilly workers discovered also that derivatives of various substituted acetic acids other than those which occur in natural penicillins could act as precursors, and these led to new penicillins containing the acyl portion of the precursor. In view of the marked specificity exhibited by most enzyme systems, the ability of the mold to utilize a variety of precursors and incorporate portions of these structures into new penicillins could hardly have been predicted. The utilization of N-(*p*-tolylmercaptoacetyl)-DL-valine to form *p*-tolylmercaptomethylpenicillin may be cited as one of numerous examples of the incorporation of a biologically-foreign substance into a penicillin.

TABLE 2

NEW CRYSTALLINE BIOSYNTHETIC PENICILLINS

Penicillin formed	Precursor used	Activity (U/mg.)	Differential assay*	Reported by:
1. Sodium *p*-methoxybenzylpenicillin	N-(2-Hydroxyethyl)-*p*-methoxyphenylacetamide	1,510	0.82	Lilly (*13*)
2. " *p*-nitrobenzylpenicillin	N-*p*-Nitrophenylacetyl-DL-valine	1,700 (?)	0.86	" (*13*)
3. " *p*-fluorobenzylpenicillin	N-(2-Hydroxyethyl)-*p*-fluorophenylacetamide	1,650	0.89	" (*14*)
4. " *m*-fluorobenzylpenicillin	N-(2-Hydroxyethyl)-*m*-fluorophenylacetamide	2,340	0.76	" (*14*)
5. " *o*-fluorobenzylpenicillin	N-(2-Hydroxyethyl)-*o*-fluorophenylacetamide	1,340	1.08	" (*14*)
6. " *p*-chlorobenzylpenicillin	N-*p*-Chlorophenylacetyl-DL-valine	2,460	0.73	" (*13*)
7. " *p*-bromobenzylpenicillin	N-(γ-*p*-Bromophenylbutyryl)-DL-valine	2,270	0.65	" (*15*)
8. " *p*-iodobenzylpenicillin	N-(2-Hydroxyethyl)-*p*-iodophenylacetamide	2,800 (?)	0.67	" (*15*)
9. " 2-thiophenemethylpenicillin	N-(2-Hydroxyethyl)-2-thiopheneacetamide	1,685	1.13	" (*13*)
10. " phenoxymethylpenicillin	N-(2-Hydroxyethyl)-phenoxyacetamide	1,670	0.87	" (*15*)
11. " *p*-tolylmercaptomethylpenicillin	*p*-Tolylmercaptoacetyl-DL-valine	1,285 (?)	0.83	" (*15*)

* The differential assay represents the ratio of activity *B. subtilis/Staph. aureus*, with that for benzylpenicillin defined as being 1.00.

In some cases addition of precursors to the culture medium caused an increase in production of penicillin activity. Such stimulation may be interpreted as strong evidence for the utilization of the precursor. In other cases no increase of total yield was experienced, and on occasion a diminution of total yield was observed. Such absence of stimulation cannot be interpreted, however, as constituting proof that the mold fails to utilize the precursor. It has been demonstrated in some cases that the precursor is utilized and the corresponding penicillin formed. For example, addition of N-(2-hydroxyethyl)-phenoxyacetamide to the culture medium did not appreciably increase the total units of penicillin activity produced, but a high percentage of the penicillin was isolated in a single fraction which was shown to be the new phenoxymethylpenicillin.

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[1] The deuteriophenylacetic acid was furnished by David Rittenberg, of the College of Physicians and Surgeons, Columbia University. N^{15}-DL-Valine was prepared and transformed into deuteriophenylacetyl-N^{15}-valine in the Lilly laboratories (*11*). The cultural work and preliminary purification were done at the Abbott Laboratories. Final purification and crystallization were effected by The Upjohn Company (*10*). The isotopic determinations were performed by Dr. Rittenberg.

A large number of compounds were prepared and tested as possible precursors of new penicillins, and in several cases the new penicillins were isolated in analytically pure, crystalline form (Table 2). Each of the new penicillins listed, except numbers 2, 8, and 11, gave satisfactory analytical values and was further identified by the ultraviolet absorption curve in comparison with that of the precursor used. The three exceptions, *p*-nitrobenzylpenicillin, *p*-iodobenzylpenicillin, and *p*-tolylmercaptomethylpenicillin, were obtained in a somewhat impure state, but the presence of these new penicillins was demonstrated by examination of their ultraviolet absorption spectra. It will be noted that *p*-bromobenzylpenicillin was isolated after the use of N-(γ-*p*-bromophenylbutyryl)-DL-valine. Examples of terminally phenyl-substituted butyl and butyryl compounds that have been used as benzylpenicillin precursors are given in Table 1. It is apparent that substituted butyric acid derivatives are effective in a manner similar to the corresponding substituted acetic acid derivatives.

Attempts to find precursors for the three-carbon moiety or the penicillamine portion of the penicillin molecule have been unsuccessful.

The following groups have participated in the joint program for the chemical study of penicillin and have contributed to various aspects of the precursor work: In Britain, British Drug Houses, Ltd.; Glaxo Laboratories, Ltd.; Imperial Chemical Industries, Ltd.; Imperial College of Science, London, Department of Organic Chemistry; and Oxford University, Department of Crystallography; in the United States, Abbott Laboratories; U. S. Department of Agriculture, Northern Regional Research Laboratory; Cutter Laboratories; Heyden Chemical Corporation; Eli Lilly and Company; Merck and Co., Inc.; and The Upjohn Company.

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The National Academy of Sciences:

Abstracts of Papers Presented at 1947 Autumn Meeting

Growth of Particles in Smokes and Clouds and the Production of Snow From Supercooled Clouds

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V. J. Schaefer introduced pellets of dry ice into clouds of supercooled water droplets and produced enormous numbers of minute ice crystals which rapidly grew into snowflakes. B. Vonnegut found that silver iodide vaporized into air can give nuclei which induce the formation of snowflakes in supercooled clouds below −5° C. Account is given of the development of these ideas from studies made during the war of fundamental aspects of: (1) gas mask filters; (2) smokes needed for screening purposes; (3) the radio interference caused by the electric charging of aircraft flying through snow; and (4) the icing of aircraft when flying through supercooled clouds. A theory of the growth of particles in aerosols has served as a guide in these various researches. The experiments in progress during the last year on the artificial production of rain and snow, now Project Cirrus with the Signal Corps and the Navy, have led to many interesting results which are described and explained. The generation and wartime use of screening smokes and the effects produced by the seeding of stratus and cumulus clouds are illustrated. A preliminary account of the flight tests over the recent hurricane of October 10–15 is given.

Physical Families of Curves

Edward Kasner

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In any field of force the most important curves are the trajectories (paths of possible motion). Thus, for the Newtonian field we have the planetary orbits, the conic sections of Kepler. Another important physical family is formed by the generalized catenaries, forms of equilibrium of a suspended chain. Other physical families in the field are brachistochrones and velocity curves.

Analogues and differences between these families are explored. The number of parameters (degrees of freedom) is always the same (three for the plane, five for space). The focal locus is always circular, but the position of the focal circle varies. The locus of the centers of all the circles is found. The fundamental theorem about starting from rest (ratio of curvatures is one-third) is generalized.

Relativistic Wave Equations

Eugene P. Wigner
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Recent work by Gelfand and Newmark (*J. Phys. USSR*, 1946, **10**, 93; cf. also V. Bargmann. *Ann. Math.*, 1947, **48**, 568) and of L. Garding (personal communication) has established that infinitesimal operators in the usual sense can be defined also for representations of open groups. The representations of the inhomogeneous Lorentz group which have been obtained previously (*Ann. Math.*, 1939, **40**, 149) by the consideration of finite transformations must also be obtainable, therefore, by considering the infinitesimal operators.

The most important combinations of infinitesimal operators which commute with all infinitesimal operators are $\mu = p_4^2 - p_1^2 - p_2^2 - p_3^2$ and $\nu = w_1^2 + w_2^2 + w_3^2 - w_4^2$, where $w_1 = M_{23}p_4 + M_{34}p_2 + M_{42}p_3$, etc., and the p and M are the infinitesimal operators of displacement and of space-time rotations, respectively. Both μ and ν assume a definite numerical value in an irreducible representation. If $\mu > 0$, one is led, as is well known, to the linear manifolds of the particles with finite mass and spins 0, ½, 1, . . . etc. If, however, $\mu = 0$, the remaining ν alone does not permit characterization of the linear manifolds. In particular, from $\mu = 0$, $\nu = 0$, the vanishing of all 6 expressions $p_j w_k - p_k w_j$ follows, and this makes it possible to define a scalar s by stipulating that $w_j \pm i s p_j$ vanish also. This discussion shows that, in some cases, the consideration of the finite operators affords a more powerful tool for the determination of the irreducible representations than the use of the infinitesimal operators only.

The manifolds with $\mu = 0$, $\nu = 0$ are well known to characterize particles with zero rest mass and spins s = 0, ½, 1, . . . etc. Manifolds which were not discussed before are obtained by setting μ zero but keeping ν finite. These manifolds can be characterized by the equations

$$(p_4^2 - p_1^2 - p_2^2 - p_3^2)\psi = 0 \qquad (1)$$

$$(\xi_1 p_1 + \xi_2 p_2 + \xi_3 p_3 - \xi_4 p_4)\psi = 0 \qquad (2)$$

$$(\xi_1 2 + \xi_2 2 + \xi_3 2 - \xi_4 2 - 1)\psi = 0 \qquad (3)$$

$$\left(p_1 \frac{2}{\partial\xi_1} + p_2 \frac{2}{\partial\xi_2} + p_3 \frac{2}{\partial\xi_3} + p_4 \frac{2}{\partial\xi_4} - i\,\Xi\right)\psi = 0. \qquad (4)$$

The ψ can be thought of as depending on the 8 variables x_1, x_2, x_3, x_4, ξ_1, ξ_2, ξ_3, ξ_4. The p then must be replaced by the corresponding $\partial/\partial x$. The infinitesimal operators of space-time rotations assume the form $M_{12} = x_1\partial/\partial x_2 - x_2\partial/\partial x_1 + \xi_1\partial/\partial\xi_2 - \xi_2\partial/\partial\xi_1$, etc. The first two terms of the M do not give any contribution to the w. As a result, when calculating ν, one obtains

$$\nu = \Sigma m_{ik}^2 \mu - \Sigma(m_{ik}m_{kl} + m_{kl}m_{ik})p_i p_l, \qquad (5)$$

where the $m_{13} = \xi_1\partial/\partial\xi_3 - \xi_3\partial/\partial\xi_1$, etc. commute with the p. The first sum vanishes because of (1); the second can be evaluated by means of (2), (3), (4) to be equal to Ξ^2. This shows that the above set of equations actually corresponds to the case $\mu = 0$, $\nu = \Xi^2$.

Solar Activity as the Origin of Cosmic Rays

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(Introduced by Harlow Shapley)

Magnetic fields of sunspots may exhibit random fluctuations of the order of from 1 to 30 gauss. These variations are associated with the gustiness and turbulence of the solar atmosphere. As one consequence of these fluctuations, the sun will emit radio noise the frequencies of which range from perhaps 2 cycles/minute to 1,000 cycles/second. Because of the long wave lengths, the radiation can escape from the sun, especially in regions where magnetic fields reduce the conductivity. The energy also can penetrate the ionosphere of the earth. Observations made with a loop antenna and audio-frequency amplifier indicate that oscillations of this type do occur on the earth's surface.

Magnetic fields limit the energy that a charged particle can assume, the light electrons being more inhibited than the heavier ions. In space, within a few million miles of the earth, heavier ions may attain energies as great as 10^{11} volts. It is suggested that cosmic rays result from such action. Cosmic-ray showers are explained as arising from a local cloud of ions and not as secondaries from a single particle. The neutron component comes from the splitting of heavier atoms into neutron-proton constituents as they encounter the earth's atmosphere.

The theory outlined above makes cosmic rays a local phenomenon. The radio waves responsible for the cosmic rays also produce other effects. They cause appreciable heating of the solar atmosphere and lead to the million-degree temperature of the solar corona. The emission exerts a cooling action on sunspots. The light of the night sky and aurora borealis are electrodeless discharges in the electric field of the radiation. Other effects include certain types of ionospheric disturbances and the existence of a potential gradient in the earth's atmosphere.

Initial Performance of a 32-Mev Proton Linear Accelerator

Luis W. Alvarez, Hugh Bradner, Hayden Gordon, Lauriston C. Marshall, Frank Oppenheimer, Wolfgang K. H. Panofsky, Chaim Richman, Robert Serber, Clarence Turner, and John R. Woodyard
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A beam of 32-Mev protons has been produced by the accelerator. Four-Mev protons from a Van de Graaff generator are injected into a resonant cavity operating at about 200 megacycles and driven by 23 oscillators delivering a total of 1.5 megawatts peak power. The beam is phase stable and is focused radially by the action of grids of tungsten wires. Absorption measurements show the beam to have an energy of 32 ± .5 Mev, in agreement with that predicted from the mechanical design. This work was done under the auspices of the U. S. Atomic Energy Commission.

The Creep and Plastic Flow of Solid Materials

Henry Eyring
University of Utah

Stresses applied to solids cause elastic deformations accompanied by plastic flow. The latter may be permanent or may disappear after the stress is removed. Maxwell long ago formalized such an analysis by writing

$$\frac{ds}{dt} = \frac{1}{G}\frac{df}{dt} + \frac{1}{\eta}f, \tag{1}$$

where s, f, t, G, η are the strains, stress, time, Hooke's law constant, and viscosity, respectively. The supposed linear dependence of rate of strain, $\frac{ds}{dt}$, on the stress, f, is not true. Thus, in certain steels increasing $\frac{ds}{dt}$ by 1,000-fold only requires a 40 per cent increase in f, and in certain textile fibers an increase in $\frac{ds}{dt}$ by 25-fold only requires a change in f of 16 per cent.

In 1936 the author showed that if plastic flow is recognized as being a relaxation process, it must obey the statistical laws characterizing chemical reactions, and equation (1) becomes

$$\frac{ds}{dt} = \frac{1}{G}\frac{df}{dt} + r\left\{\frac{kT}{h}e - \frac{\Delta F^*}{kT}\right\}\left(e\frac{f_{v_1}}{kT} - e - \frac{f_{v_2}}{kT}\right). \tag{2}$$

Here, r is dimensionless, and for tension becomes the ratio of the increase in length for each individual relaxation event divided by the distance between relaxing regions in the direction of extension; the bracketed expression is the usual expression for a rate of reaction; f is the applied force per unit area and, when multiplied by the volume V_1, gives the work done on the relaxing unit as it passes from the normal to the activated state; f_{v_2} is the extra work a unit reversing the relaxation must do against the applied force. When f_{v_1} and f_{v_2} are small compared with kT, equation (2) reduces to (1). In other cases, the exponential dependence of $\frac{ds}{dt}$ on f quantitatively explains the previously observed nonlinearity. For a symmetrical potential barrier, $V_1 = V_2$. This relaxation theory has been found extremely useful in explaining the observed plastic behavior of textiles, rubber, metals, and inorganic nonmetals. Some of these results are shown.

Equation (2) provides an explanation for some results reported by Bridgman in which large hydrostatic pressures greatly increase breaking strengths. Thus, the free energy of activation, ΔF^*, for any rate process can be written as

$$\Delta F^* = \Delta F_0^* + p\overline{\Delta V}.$$

Here, ΔF_0, which is the free energy of activation at zero pressure, is increased by the pressure multiplied into the mean volume of the hole, $\overline{\Delta V}$, required to permit the flow process. Thus, in (2), if $\overline{\Delta V}$ is about the size of V_1, it is clear that any increase in pressure will cause a corresponding increase in the stress per unit area, f, necessary to maintain a given rate of distortion. Pressure, by selectively slowing down the processes involving the larger holes, $\overline{\Delta V}$, changes the nature of the flow process. The effect of pressure in increasing breaking strength in particular is due to the slowing down of the individual rate processes involved in breaking.

So far as we are now able to see, all deformation problems are interpretable in terms of the individual relaxation processes which have been briefly sketched.

Viscosity, Sedimentation, and Diffusion of Polymers in Solution

P. Debye and Arthur M. Bueche
Cornell University

Staudinger suggested that the intrinsic viscosity of a polymer solution should be proportional to the molecular weight of the polymer molecule. In the course of time it has been shown that a rule stating proportionality with another power of the molecular weight (usually between 1 and ½) represents the experimental facts much better. A similar behavior is found for the sedimentation and diffusion constants.

It seems important to investigate whether such relations are more than convenient interpolation formulae and, if it should turn out that they are not, to find which relations should be substituted. If such more fundamental relations can be found, it remains to be seen in which sense the customary power relations can be considered as an approximation and what the significance is of the numerical constants, entering in such relations, in terms of the molecular structure of the polymer molecule.

The polymer molecule is represented as a pearl string, with beads representing the monomer and freedom of motion of its links representing the more or less restricted freedom of rotation of the chemical bonds around each other. Such a model leads to Staudinger's original rule, provided it is assumed that the disturbance of the general flow in the liquid due to each bead dies out so rapidly with increasing distance that its effect on the flow around the other beads can be neglected. This, however, does not hold, and the situation is analogous to that of a dielectric in an electrical field, a case in which the electric moments of the different elements of volume of the dielectric create an additional field which has to be taken into account.

The mathematical problem of taking into account the interaction of the beads has been put in a simplified mathematical form. The flow is calculated around and through a spherical particle, the interior of which offers an added resistance to the flow proportional to the number of beads it contains per unit volume. The computed velocity distribution is used in order to calculate the intrinsic viscosity. This quantity now depends on (a) the volume of the sphere, (b) a number, which has been called the "shielding ratio," defined as the quotient of the radius of the sphere and a length, the "shielding length," which is proportional to the reciprocal of the square root of the bead density within the sphere. This length measures how far the effect of the outside velocity distribution reaches into the interior of the sphere.

Discussing the intrinsic viscosity as a function of the degree of polymerization of the polymer chain according to this theory, it is found that for short chains the intrinsic viscosity is proportional to the molecular weight. With increasing chain length this increase is retarded, and in the limit for very long chains the intrinsic viscosity becomes proportional to the square root of the molecular weight. Over a restricted region of molecular weights the curve can be approximated by a power of the molecular weight between 1 and ½. This exponent of the power rule is a measure for the shielding ratio. After this shielding ratio has been determined, measurements of the intrinsic viscosity can be used to determine the average space occupied by the polymer chain in the solvent. In the case of polystyrene, the size of this space calculated from viscosity compares favorably with the size determined by an interference method based on the observed angular dissymmetry of the light scattered by the solution.

Similar calculations for the sedimentation and diffusion constant have been made by A. M. Bueche. Again, the power rule is interpreted as an approximation and its exponent explained as an effect of the shielding.

Influence of Ultrasonic Irradiation Upon the Phase Transition in the Formation of Colloidal Sulfur

Victor K. La Mer and James W. Yates
Columbia University

When dilute sodium thiosulfate (0.0012M) and HCl (0.0024M) are mixed, the resulting solution remains crystal clear for a reproducible time of 47±1 minutes. The reproducibility of this time appears to be independent of the source of the distilled water. Measurements (La Mer and Kenyon. *J. colloid Sci.*, 1947, 2, 257; Johnson and La Mer. *J. Amer. chem. Soc.*, 1947, 69, 1187) of the ultraviolet absorption (3,100 A.) in a Beckman Spectrophotometer show that molecularly dispersed sulfur is being continually produced at an accelerating rate until a critical limiting degree of supersaturation ($\sim 3.10^{-5}$ g atoms S/l.) is reached which can no longer be tolerated by the system. This time limit is signalized by the appearance of a Rayleigh type of Tyndall beam. It corresponds to a phase transition wherein the molecularly dispersed sulfur is converted into droplets of supercooled λ sulfur of a size sufficient to exhibit perceptible light scattering, in both the ultraviolet and the visible regions.

Attempts to alter the time of this phase transition by the addition of foreign nuclei, by redistillation of the water *in vacuo*, removal of dissolved gases by boiling, and increasing the content of nitrogen by shaking under 20 pounds of pressure, have proven thus far to be without significant effect.

In view of the well-known property of ultrasonic waves to relieve supersaturation (Sollner. *Chem. Revs.*, 1944, 34, 388), irradiation of the reaction solutions was tried at 400 kilocycles. The results were startling. The normal time of 47 minutes was increased fourfold. More carefully planned experiments show that the effect is not due to the production of H_2O_2 or any detectable chemical change upon the reactants. In fact, the delay can be produced simply by irradiating the distilled water to which the proper amount of concentrated HCl and thiosulfate is added after the treatment. In these cases two to four minutes irradiation of distilled water delays the onset of the phase transition to 3–7 hours.

Preliminary measurements on the ultraviolet absorption show that the production of molecularly dispersed sulfur from the homogeneous reaction continues beyond the normal period of 47 minutes, resulting in a much higher (~5-fold) degree of supersaturation than exists at the normal time limit for the transition to colloidal sulfur.

It would appear that the ultrasonic radiation removes some unknown nuclei, presumably present in fairly constant number in distilled water, which normally play a role in the condensation process in the colloid formation. The normal phase transition is apparently not one of self-nucleation, as was formerly assumed.

When the initial concentrations of HCl and $Na_2S_2O_3$ are systematically varied, the normal timing of the transition is affected in a reproducible manner, the normal critical limiting supersaturation appears to be constant, but the number of particles formed, as judged by the light absorption as a function of wave length (Barnes and La Mer. *J. colloid Sci.*, 1946, 1, 79; Barnes, Kenyon, Zaiser, and La Mer. *Ibid.*, 1947, 2, 333), varies with the concentration.

When the irradiated water is divided into two aliquots, one of which is carefully protected from air and atmospheric dust and the other is not, the times were found to be roughly 7 and 3 hours, respectively. Experiments are in progress to test various hypotheses of the nature of the nucleation process.

Recent Experiments With the 184-Inch Cyclotron

R. L. Thorton
University of California
(Introduced by E. O. Lawrence)

Study of disintegrations and other nuclear processes involving nuclear projectiles of energies in the neighborhood of several hundred million electron volts will yield important information about the structure of the nucleus, and many laboratories here and abroad are building or planning equipment to reach these energies. The 184-inch cyclotron of the Radiation Laboratory has now been in operation for about one year and provides deuteron and alpha-particle beams of 190 and 380 Mev, respectively. When the deuteron beam strikes any target, splitting of the deuterons yields, in addition, neutrons and protons of energies centering about 90 Mev and emitted in a narrow cone about the deuteron direction. Many experiments have been carried out using these radiations. The results of some of these, and their significance, are discussed.

When these fast particles are incident upon a nucleus, the disintegrations are often more complex than those found at lower energies and frequently result in the ejection of many neutrons, protons, and alpha particles. In addition, fission is produced among many of the heavier elements and has been observed for atomic numbers as low as tantalum. (Such fission produced by very high-speed particles has, of course, no immediate application in the utilization of atomic energy.) Such nuclear events are observed in the cloud chamber and photographic emulsions as well as being deduced from a study of the radioactive isotopes produced.

Other experiments have indicated that nuclei, especially the lighter ones, are partially transparent to very fast particles. Thus, a fast neutron is apparently able to pass through a nucleus with the loss of only a fraction of its incident energy. Experiments indicating this are measurement of total neutron cross-sections and excitation curves for certain nuclear reactions involving light elements.

Evidence of exchange reactions, whereby a fast neutron entering a nucleus will exchange identity with a nuclear protón and emerge as a high-speed proton, has been found in a study of neutron-proton scattering. Interactions of this type have long been proposed as contributing to nuclear forces.

Application of X-Ray Diffraction Phase Determinations to the Study of the Structures of Crystals Containing Large Molecules

David Harker
General Electric Company

(Invited paper)

Crystals are three-dimensionally periodic structures with repeating units composed of a small number of atomic groupings which may be molecules or ions. The electron distribution of a repeating unit gives rise to variations in the intensities of X-rays diffracted by the crystal in different directions. It is possible to correlate the directions of diffraction with sets of three integral numbers, h, k, ℓ; and the intensities diffracted in these directions can be interpreted as the squares of the corresponding coefficients of the Fourier Series representing the electron distribution in a repeat unit of the crystal. Thus, the Fourier Series for a crystal is

$$\rho(x, y, z) = \frac{1}{V} \sum_{h=\alpha}^{\alpha} \sum_{k=\alpha}^{\alpha} \sum_{\ell=\alpha}^{\alpha} F_{hk\ell}\, e^{2}\, \pi i(hx + ky + \ell z),$$

where $\rho(x, y, z)$ is the density of electrons at the point (x, y, z); V, the volume of one repeat unit; h, k, and ℓ, integers; and $F_{hk\ell}$, a number whose square has a magnitude proportional to the observed intensity of X-ray diffraction in the direction characterized by h, k, and ℓ.

The difficulty in finding a structure from an X-ray diffraction pattern is due entirely to the fact that the sign (or phase) of $F_{hk\ell}$ cannot be found from $|F_{hk\ell}|^2$, which is what is observed. Various methods of solving this problem have been attempted—none with complete success. Of these, the one due to J. S. Kasper and the speaker seems most likely to lead to the determination of such complex structures as those of proteins.

This method is based on the discovery that the signs (or phases) of some $F_{hk\ell}$'s are related to the squared magnitudes, $|F_{h'k'\ell'}|^2$, of other $F_{h'k'\ell'}$'s. These relationships are in the form of inequalities, such as

$$\frac{|F_{hk\ell}|^2}{(Z\hat{f}_{hk\ell})^2} = \frac{1}{2}\left(1 + \frac{F_{2h2k2\ell}}{Z\hat{f}_{2h2k2\ell}}\right),$$

where $(Z\hat{f}_{hk\ell})^2$ is the maximum possible diffracted intensity in the h, k, ℓ direction for any arrangement of the atoms in the given crystal. The use of this and analogous inequalities can yield the signs (or phases) of enough $F_{hk\ell}$'s to allow an approximate determination of the values of $\rho(x, y, z)$, *i.e.* of the crystal's structure. This crude picture can then be refined by other well-known methods.

Some Recent Studies on Fluorescence

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University of Rochester

The study of fluorescence provides one means of obtaining information on the transfer of energy between molecules on collision. The blue fluorescence of acetone has been studied with sufficient care to show that there are discrete bands. Thus, either it is emitted by excited molecules of acetone or by free radicals in the excited state. There is not enough energy for the latter process. The temperature dependence of the fluorescence indicates that the excited molecules have a stability dependent on vibrational excitation. The transfer of energy between polyatomic molecules during collisions of the second kind has never been fully investigated. The relationship between energy transfers of monatomic, diatomic, and polyatomic molecules is briefly discussed.

Long-Distance Interaction Between Protein Molecules

Alexandre Rothen
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(Invited paper)

When films of antigen (protein or polysaccharide) are transferred onto metal slides, these films are capable of adsorbing specifically layers of homologous antibody as much as 300 A. thick under certain conditions. Blankets made of barium stearate, octadecylamine, or different plastic materials can be deposited upon the antigenic layers. It is found that, when immune homologous antisera are deposited on top of such blankets, a specific immobilization of homologous antibody takes place in spite of the intervening thickness of the blanket. The possibility of holes in the blankets, thus allowing the antibody molecules to come in direct contact with the antigenic layers by diffusion seems contrary to the experimental evidence. The conclusion is reached that interaction between large molecules involved in immunological reactions may take place through a field of specific long-range forces extending over 200 A.

Experimental evidence indicates that certain enzymes can exert their action on films of antigen through intervening blankets of plastic material. The thickness of the blankets necessary to protect the antigenic layers depends greatly on the number of these layers and their mode of deposition—a fact which shows that the phenomenon involved is not a simple diffusion of the enzyme molecules.

The Size, Shape, and Charge Distribution of Protein Molecules

J. L. Oncley
Harvard Medical School

(Invited paper)

Protein molecules, unlike other macromolecules, usually contain large numbers of positively and negatively charged groups as well as polar and nonpolar groups arranged in specific positions in rigid structures. Many chemical and biological properties of proteins depend upon the size and shape of these molecules and the positions of the groups in the molecules. These quantities are fundamental in any theory describing the electrostatic interactions and the molecular-kinetic behavior of proteins.

Estimates of size, shape, and charge distribution have now been made for many proteins. These estimates have been obtained from studies of sedimentation and diffusion, osmotic pressure, viscosity, double refraction of flow, and dielectric constant.

As a first approximation, protein molecules may be represented as ellipsoids of revolution, although these shapes are unquestionably too simple to be completely adequate. Using this assumption, scale models have been constructed of a number of proteins characterized in our laboratory. The β_1-lipoprotein is the most symmetrical of these molecules, but a number—serum albumin, egg albumin, and β_1-metal binding protein—have only slight asymmetry. Fibrinogen appears to be far more asymmetrical, a property closely related to its ability to form clots under certain conditions. Completely undegraded gelatin, more like fibrous proteins and synthetic polymers, has about the same length but half the width of fibrinogen.

In certain cases physical-chemical studies have led to more detailed models. Insulin, as it exists in neutral aqueous solution, has been demonstrated to be reversibly dissociated into three smaller units in acid solutions. Hemoglobin under quite different conditions dissociates into two smaller units.

Electromotive force measurements, combined with analytical studies of the amino acid composition, give reliable estimates of the number of positively and negatively charged groups. The distribution of these charges, as evaluated from dielectric constant measurements, is sufficiently asymmetrical to yield dipole moments much greater than those of other known molecules. The most asymmetrical charge distributions were observed for β-lactoglobulin, serum γ-pseudoglobulin, β_1-metal binding protein, and edestin. Egg albumin and serum albumin appear to have almost symmetrical charge distributions.

Although finer tools will be required to give detailed descriptions of molecules as complex as even the simplest protein, this approach to our understanding of their structure has yielded helpful models of proteins.

Synthesis of Polypeptides

R. B. Woodward
Harvard University
(Invited paper)

Complete hydrolysis of proteins by drastic chemical methods gives mixtures of α-amino acids. By gentler chemical methods, and in particular by enzymatic processes, cleavage products may be obtained which contain two, three, or more amino acids linked by simple amide bonds. These facts have led to the view (Fischer) that the fundamental structural feature of all proteins is that of a long polypeptide chain. The occurrence of variously constituted amino acid units, the opportunity for many different arrangements of units within the chain, and in particular secondary structural features, such as cross-linking between chains by primary bonds, hydrogen bonds, or ionic forces, and manifold opportunities for coiling of long chains, all serve to differentiate the various natural proteins and to confer on each individual certain characteristic properties. In general, these secondary structural characteristics appear to be more important in defining the properties of the globular proteins than of the fibrous proteins. The latter have properties more nearly like those to be expected of rather simple high polymers having the fundamental chain unit (—CO—CH(R)—NH—), though even in this class the molecules do not appear to consist of single chains, but rather of bundles of two or more chains which may associate end to end in the formation of fibrils. Denaturation, the transformation of globular proteins to fibrous modifications, probably involves the unfolding of such a bundle of polypeptide chains, which in the globular modification is tightly coiled in a very specific manner.

The properties of the proteins and the structures to which these properties may be attributed are clearly very complicated, but no evidence has been forthcoming which indicates that the complication is one of kind rather than of degree. To the organic chemist the structural forces in the proteins are the same as those operative in the simple molecules with which he is familiar, and the complications arise only from the large numbers of combinations and arrangements of simple atomic interactions. Classically, the task of the organic chemist, once the fundamental structural features of a molecule have been elucidated, is that of synthesis—the duplication to the extent that is possible, of the structure put before him. In the case of the proteins, the first step is clearly that of developing methods for the synthesis of long polypeptide chains. The classical many-step methods of organic synthesis are unsuited to the preparation of materials of high molecular weight, and it is clear that the solution of the problems requires the use of the methods of addition polymerization or an analogous process.

The monomeric species for such a scheme, and indeed the addition polymerization reaction, have long been known, though not recognized as such. Recently, by the polymerization, under carefully chosen conditions, of properly constituted monomers, the synthesis of molecules containing long polypeptide chains with any desired number of different units has been achieved. The preparative results as well as mechanistic considerations and the molecular and physical properties of the products are discussed. The extent to which the phenomena shown by the synthetic materials duplicate those of natural proteins and possibilities for the future, particularly in the testing of hypotheses as to correlations of properties of natural proteins with structural features, are considered.

The Nutritional Significance of Amino Acid Imbalance

C. A. Elvehjem
University of Wisconsin

An interesting relationship between vitamins and amino acids was established when a niacin deficiency was produced in the rat through the use of a diet high in corn and low in proteins. This deficiency was counteracted by the addition of niacin or tryptophane. Evidence is available that tryptophane may function as a precursor of niacin in the animal body.

Further studies with synthetic rations containing 9 per cent of casein have shown that protein hydrolysates, mixtures of amino acids, and specific amino acids produce a significant retardation in growth which may be reversed by the addition of either niacin or tryptophane. Threonine and phenylalanine showed the highest activity of any of the amino acids tested.

The significance of this amino acid imbalance in the prevention of pellagra, in the use of protein hydrolysates and amino acids in therapy and in laboratory studies in which free amino acids are used in place of the intact protein, is discussed.

The Site of Cell Growth

Paul Weiss
University of Chicago

When a nerve fiber is partially constricted, the part lying distal to the constriction (*i.e.* at the far side from the cell nucleus) assumes a reduced diameter, while an excess of cytoplasm piles up at the proximal (*i.e.* near-nuclear) side of the "bottleneck." This condition becomes permanent. Various experiments of this type have led to the conclusion that nerve cells are in a state of sustained growth, new protoplasm being continually produced at the site of the cell nucleus and then pressed distad into the fiber. Constriction causes the observed changes in fiber caliber by throttling the centrifugal convection of cytoplasm. When the constriction is later removed, the dammed up cytoplasm can be seen to advance distad. The rate of this advance is of the order of 1 mm./day.

In explanation of this phenomenon, the hypothesis is proposed that the basic protoplasmic systems of the cell, particularly native proteins, cannot be synthesized in the cytoplasm but must be supplied from a nuclear source. On this premise, the rate of presumable natural protein decay in nerve was calculated from known values of ammonia production, and from this the rate of replacement requisite for maintenance of steady state could be derived. This postulated replacement rate was found to be of the same order as the observed rate of proximodistal convection of protoplasm, thus lending support to the proposed concept.

The results indicate a very close relation between the genic apparatus of the cell, protein reproduction, and the sources of protoplasmic growth.

Some Theoretical and Experimental Relationships Between Infrared Absorption and Olfaction

Lloyd H. Beck and Walter R. Miles
Yale University

According to the proposed theory, olfaction results when the radiation of heat from an organism's receptors is accelerated. The source of heat is the organism itself. The organismic source defines the critical region of the infrared spectrum as that in the neighborhood of the maximum of a black body at approximately 290°–313°K. The receptors, being of the dimensions of the wave lengths in the region of this maximum (8–14 μ), can, by virtue of their size and shape, radiate selectively. Any substance having an absorption band in this region and coming within the radiation field of these receptors will cause them transiently to lose energy. This transient loss of energy is presumably the initial event in the process of stimulation of the olfactory receptors. Differential radiation losses of the receptors account for olfactory quality as spatial stimulation.

In a group of roaches (*Periplaneta americana*) placed between glass chambers equipped with potassium bromide (KBr) windows, one of which was backed with glass, 15 per cent showed antennal activity when air was pulsed through the chambers, 24 per cent showed activity when oil of clove vapor was pulsed through the chambers, and 26 per cent showed activity when oil of clove was released diffusely in the room. These results could have occurred by chance 3 times in 100.

The present theory rationalizes the experimental literature on olfaction. Among other points, it distinguishes odorous from inodorous substances; explains adaptation as the return of the receptor system to a new thermal equilibrium in the presence of an odorous substance; accounts for the differences between micro- and macro-osmatic animals on the basis of the larger absorption chambers of the latter; accounts for the anomalies in the chemical theory; and provides a basis for the reinterpretation of some of the classic work in olfaction.

Electrical Responses of the Human Retina to Stimulation by Lights of Various Wave Lengths

Lorrin A. Riggs
Brown University
(Introduced by Walter S. Hunter)

A contact lens is used to maintain a constant electrical contact between the cornea of the eye and a nonpolarizable electrode. Continuous records are made of the difference of potential existing between this electrode and a reference electrode located elsewhere on the head. When light enters the eye, an electrical response occurs which is manifested as a momentary increase in the positivity of the corneal electrode. That the effects so observed originate in the retina or sensitive layer of the eye has been shown conclusively in various control experiments. The exact nature of the retinal events underlying the electrical response is not well understood at present. The evidence from our recent experiments does show, however, that the scotopic or night visual system is chiefly responsible for the magnitudes and wave forms of the recorded responses. Responses obtained during the process of dark adaptation reveal, for example, that the sensitivity of the eye continues to rise over a period of more than an hour, even when tested with red light. The rate at which visual sensitivity appears to rise in these experiments is consistent with the scotopic portion of the curve of dark adaptation as conventionally obtained by determination of visual thresholds. In other experiments, the eye has been adapted to a constant level of illumination, whereupon electrical responses are elicited by means of test flashes of added illumination. The result again is consistent, for 5 different levels of light adaptation, with the predicted effects of such adaptation upon the scotopic system of the retina. In other experiments, various wave lengths of stimulating flash have been used to reveal the visibility function, based upon magnitudes of electrical response. This function resembles fairly closely the scotopic visibility curves which have been determined by many investigators using a conventional matching procedure. It is concluded that the contact-lens method of recording visual sensitivity has the following characteristics: (1) It provides objective and measurable responses which are not influenced by error of subjective estimation. (2) It reflects only the activity of the retina, uncomplicated by effects occurring in the higher visual centers. (3) It reveals the activity of the scotopic visual system under conditions of light adaptation such that scotopic functions cannot be observed by the usual psychophysical methods because of the intrusion of the photopic system. (4) In spite of the value of the electrical response as an indicator of scotopic sensitivity, its exact nature and point of origin are not well understood.

Infrared Absorption in Field Studies of Olfaction in Bees

Walter R. Miles and Lloyd H. Beck
Yale University

The problem in these studies was to determine if infrared absorption bands influence the olfactory behavior of bees. Duplicate units made of cast iron provided the chambers for liquid honey, gas from the honey, and a moisture absorber. An open cooling chamber adjoined the solid end of each gas chamber, a window being sealed into the other end. For chamber "S" the window was a special infrared filter. For chamber "XS" the same filter was used with glass behind it. On small platforms in front of each window a measured number of drops of honey were placed and exposed to the open air in order to attract the bees to work near and in front of the two windows. After the platforms were removed, the subsequent behavior of the bees was studied. They now clustered on the infrared passing window in the ratio of from 3–10 to 1 on the "XS" window. Variations of this experiment have demonstrated, in terms of proportional statistics, reliable indications that the bees prefer the window which passes infrared from the honeyed perfume inclosed in the chamber behind it. These results appear to support the hypothesis that infrared absorption bears a relation to the adequate stimulus for olfaction.

The Predictiveness of Infant Behavior Traits

Arnold Gesell
Yale University

The Yale Clinic of Child Development has made numerous diagnostic and follow-up studies of the growing behavior patterns of normal, atypical, and abnormal infants. The infants were examined at periodic intervals with stenographic recording. A clinical crib, a test table, and test objects were designed to elicit characteristic responses in the four major fields of behavior: motor, adaptive, language, and personal-social. Cinema records of the behavior patterns have been subjected to frame-by-frame inspection and to quantitative analysis. Selected children were observed for a period of 10 years; one pair of identical twins has been intensively followed from infancy for a period of 20 years.

These studies indicate a high degree of predictability in the sequences of mental growth. The sequences follow a general ground plan with variations which are distinctive for each individual. Normal infants in the first three months of life tend to lie with head and arm directed to one side, the opposite arm being crooked at the shoulder. This "tonic-neck-reflex" pattern may be right or left or mixed. Deep-seated preference for the left is predictive of ultimate lefthandedness.

With the aid of finely graded norms of behavior growth, a clinically trained diagnostician can appraise the developmental potentials of the infant. By systematic methods of developmental diagnosis it is possible to diagnose in the first year of life nearly all cases of amentia, cerebral injury, sensory and motor defects, and serious personality deviations. One or two examinations in infancy usually suffice to determine whether a child is suitable for adoption and whether the developmental outlook is favorable, highly favorable, or unfavorable. Examinations in infancy and observation during the preschool years may reveal various forms of giftedness, temperamental qualities, individual modes of growth and learning, and liabilities and assets in emotional make-up.

All these possibilities in the realm of prediction have been demonstrated by clinical applications which operate with significant success when based on a precise knowledge of the developmental mechanisms involved. This knowledge is now only in its crude beginnings. The task of science is to refine the knowledge. Refinement of knowledge will lead to refinement of prediction. A greater concentration of scientific resources on the period of early infancy becomes of supreme importance for preventive medicine and other forms of social control.

Tepexpan Man: A Study of an Ancient Human Skeleton From the Valley of Mexico

Javier Romero
Museo Nacional of Mexico
T. D. Stewart
U. S. National Museum
(Introduced by Alexander Wetmore)

Restoration and study of the human skeleton of late Pleistocene age from near the present town of Tepexpan, Mexico, has now been completed by Sr. Romero under the guidance of Dr. Stewart. Restoration has involved reassembling the broken parts of the face and of the major long bones. The skull is reasonably complete, but the long bones, except for the right radius and ulna, are deficient. Only a few other parts are present or complete enough for study.

In shape, the skull is on the border of brachycrany (C.I. 80) and relatively high. Cranial capacity is high (1,540 cc.), and the endocast shows a well-developed brain. The skull type is close to that of the late Indians of our Southeast. Suture closure indicates advanced age (55–65 years). Sex characters are masculine.

Computation of stature from long-bone measurements yields a figure of approximately 170 cm., which is well above the present average of Mexican Indians. Arthritic changes, notably in the cervical vertebrae, are consistent with the attributed age.

A sculptural representation of the soft parts of the head, built upon a cast of the skull and taking into account average tissue thicknesses for whites, shows a typical Indian countenance. This head epitomizes the conclusions of the study, namely, that Tepexpan Man was a typical Indian, although bigger than those living today in Mexico.

The Viking Fund of New York made it possible for Sr. Romero to bring the specimen to Washington, where the Smithsonian Institution supplied laboratory facilities and study collections.

Bikini Revisited—Preliminary Results of the Scientific Resurvey During the Summer of 1947

Commander Roger Revelle, USNR
Geophysics Branch, Office of Naval Research

During July and August of 1947 the Navy Department, in cooperation with other government agencies, carried out a scientific resurvey of Bikini Atoll in order to study the effects of radioactivity on marine organisms living in a natural environment and to extend certain aspects of the geological, biological, oceanographic, and military investigations conducted in this little known area during 1946. Approximately 60 civilian scientists and technicians participated in the resurvey, representing the U. S. Geological Survey, the Fish and Wildlife Service, the National Museum, the Navy Department, the Atomic Energy Commission, and various universities and research institutions. Four ships were assigned to the expedition including the *U.S.S. Chilton*, a transport of about 15,000 tons.

Although fishes and other marine animals from the entire lagoon area were often found to contain slight amounts of radioactivity, no large-scale changes were observed in population density of reef or pelagic animals or in the relative abundance of different species. Some coral patches in the target area showed evidence of destructive effects due to the atomic bomb explosions. Reproductive processes in living organisms appeared normal, and no morphological changes were found. Studies of permeability, salt accumulation, bioelectric potential, pigment content, photosynthesis, respiration, enzyme activity, and calcification were carried out on marine algae. Only one difference, a higher activity of the hydrogen peroxide decomposing enzyme, catalase, was noted between areas which had received heavy doses of radiation from radioactive substances and those which had not been affected by radiation. Marine bacteria and land organisms appeared unaffected by radiation. In the eastern end of Bikini lagoon the water is considerably more turbid than in the spring of 1946; the cause of this change is not well understood.

The subsurface structure of Bikini Island on the eastern end of the atoll was explored by core-drilling down to a depth of 2,556 feet, nearly two and a half times as deep as the Funa Futi boring, the only previous drilling on a coral atoll. Unconsolidated or very poorly consolidated calcareous sediments—beach rock, reef limestone, coral rubble, and calcareous sand—were found at all depths. Preliminary examination by geologists and paleontologists of the U. S. Geological Survey shows that late Tertiary corals and mollusks were encountered at 930 feet, and it is possible that the top of the Tertiary section may be considerably higher. Seismic velocity determinations in the deep hole suggest a continuous transition to more compacted calcareous materials near the bottom. On the basis of previous geophysical evidence, these may extend down to depths of one to more than two miles.

Studies of the deposition of calcium carbonate indicate a rate of upward growth of the reef of about 1 mm. per year.

Twenty-four dredge hauls were made on the outer slopes of the reef. These show that the outer slope consists near the surface of large blocks of limestone mixed with calcareous sand. The size of the blocks decreases with depth from several tons near the surface to several hundred pounds at depths of more than 200 fathoms. Below 200 fathoms these limestone blocks are rare. From 10 to 100 fathoms, living corals, algae, bryozoa, sponges, and other forms are present in abundance. The profusion and variety of life decreases rapidly with depth; below 100 fathoms the predominant forms are foraminifera, algae, a few deep-water corals, sponges, and brachiopods.

NEWS *and Notes*

The winners of the two $1,000 AAAS-George Westinghouse Science Writing Awards for 1947 were selected in New York City on November 20. George A. Keaney, feature writer on the *New York World-Telegram* won the 1947 Newspaper Writing Award for his series of five stories on blood, and more especially on the Rh factor of blood, which appeared in the *New York World-Telegram*, March 18–22, 1947. This year's Magazine Writing Award was won by Steven M. Spencer, associate editor of the *Saturday Evening Post*, for his story, "New Hope for the Anemic" (an article on folic acid), which appeared in the December 14, 1946, issue. The judges further recommended that honorable mention for the Magazine Writing Award be given Lorus J. and Margery J. Milne, free-lance writers, for their article, "The Life of the Water Film," published in the June 1947 issue of *Natural History*.

A newspaperman for only three years, Mr. Keaney had taught English and civics in the Lawrence, Massachusetts, high school for 13 years. He was born in Lawrence in 1906 and later received his A.B. and M.A. degrees in English from Boston College.

Steven Spencer was awarded a Nieman Fellowship in Journalism at Harvard University in 1939 while he was employed on the *Philadelphia Bulletin* as staff science writer. He later contributed articles to the *Saturday Evening Post* and joined its staff in 1946. Mr. Spencer was born in Omaha, Nebraska, and received an A.B. degree in English at the University of Pennsylvania. He is now living in Swarthmore, Pennsylvania.

The Milnes have contributed to several general circulation magazines during the last year as free-lance writers. They are now living in Burlington, Vermont, where Dr. Milne is associate professor of zoology in the University's Department of Zoology. Mrs. Milne was formerly associate professor of biology at Beaver College, Jenkintown, Pennsylvania.

The $1,000 Newspaper Writing Award was made for the first time at the Boston meetings of the AAAS in Chicago, and the Magazine Writing Award was incorporated into the annual program for the 1947 contests. Both of the 1947 awards will be made at a presentation dinner on December 27 during the AAAS meetings in Chicago. Upon this occasion Dr. Shapley will act as toastmaster, and the guest speaker will be George Stoddard, president of the University of Illinois. Through funds provided by the Westinghouse Educational Foundation of the Westinghouse Electric Corporation and under the administration of the AAAS, the annual science writing awards are made in an effort to stimulate and maintain a high standard of science reporting for the lay public through the newspapers and the general circulation magazines.

The judges selecting the 1947 winners were: Benjamin McKelway, editor of the Washington *Star*, and H. L. Mencken, of the Baltimore *Sun* papers, representing newspapers; Clifton Fadiman, of *'47*, and Edward Weeks, of the *Atlantic*, representing magazines; Kenneth Olson, of the Medill School of Journalism of Northwestern University, and Rudolf Flesch, author of *The art of plain talk*, general representatives; and Detlev Bronk, chairman of the National Research Council, and Edward Weidlein, of the Mellon Institute for Industrial Research, representing science. Dr. Morris Meister acted as chairman of the judging panel.

Visible Directory, Chicago Meeting

Advance registrants, please note: As soon as your hotel reservation in Chicago has been made, either notify the Washington Office of the name of your hotel or, upon your arrival in Chicago, give this information to the attendant at the Information Booth in the Stevens Hotel for posting in the Visible Directory.

About People

James B. Sumner, professor of biochemistry, Cornell University, and the first to crystallize an enzyme, has been appointed director of the Laboratory of Enzyme Chemistry, recently established by the trustees of Cornell University. Dr. Sumner was co-winner of the 1946 Nobel Prize in Chemistry. The new laboratory will be located in Savage Hall, the new building of the School of Nutrition (*Science*, October 10, November 14).

Samuel C. Schmittle has been appointed assistant in the Department of Veterinary Pathology and Hygiene, University of Illinois College of Veterinary Medicine. Dr. Schmittle was graduated from the Ohio State Veterinary College in 1947.

John C. Keresztesy, chemist, Cancer Research Laboratory, Mt. Sinai Hospital, New York City, has been commissioned in the U. S. Public Health Service and has been assigned to the Physiology Division, National Institute of Health, Bethesda, Maryland.

Florence B. Seibert, associate professor of biochemistry, Henry Phipps Institute, University of Pennsylvania, received the honorary D. Sc. degree from Lafayette College, Easton, Pennsylvania, at the Founders' Day exercises, October 18.

Thomas G. Digges, a member of the Metallurgy Division, National Bureau of Standards, since 1920, has been appointed chief, Thermal Metallurgy Section, succeeding **D. J. McAdam,** chief of the Section since 1930, who retired August 31.

Grants and Awards

A publication of the American Chemical Society, *Industrial and Engineering Chemistry*, has been awarded first prize for 1947 for "the best issue devoted to a single theme" in the annual competition sponsored by *Industrial Marketing*, Chicago, among the nation's business journals. The award, a silver plaque, was conferred in recognition of the quality and scope of articles on the utilization or disposal of industrial wastes which made up the May issue of the journal, which is edited by Walter J. Murphy, Washington, D. C.

The Seventh Annual Science Talent Search, sponsored by Westinghouse Electric Corporation and Science Service, is now under way. Examinations will be given to the contestants from December 1 to 26, the closing date. From the 300 top-ranking contestants, 40 will be chosen for all-expense trips to the five-day Science Talent Institute in Washington, D. C., February 27 through March 2, 1948, during which the winners will be selected. One girl and one boy will receive $2,400 Westinghouse Grand Science Scholarships ($600 a year for four years) and 8 others will receive scholarships of $400 ($100 a year for four years). An additional $3,000 worth of scholarships may be awarded to others of the 40 at the discretion of the judges. Concurrently with the national talent search, 9 states (Alabama, Georgia, Illinois, Iowa, Louisiana, Montana, Pennsylvania, Tennessee, and Virginia) will conduct state searches through a special arrangement with Science Clubs of America. The judges are Harlow Shapley, director, Harvard College Observatory, and president of the AAAS; Harold A. Edgerton and Steuart Henderson Britt, psychologists of New York City; and Rex E. Burton, psychiatrist of Washington, D. C. By discovering and developing scientific ability at the high school level the two sponsoring institutions, Westinghouse and Science Service, are playing a major role in relieving the critical shortage in scientific talent which is the growing concern of most countries of the world today. More complete information on this program may be obtained from Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

The Research Corporation, New York, has recently made several awards of interest. Two physics teachers, **A. A. Knowlton,** Reed College, Portland, Oregon, and **Clifford N. Wall,** formerly at North Central College, Naperville, Illinois, and now at the University of Minnesota, received special awards of $1,000 each for distinguished teaching. A survey had shown that of all physicists granted Ph. D. degrees in this country between 1936 and 1945, an outstanding number had been undergraduates at Reed and North Central. Two other awards, each consisting of a plaque and a $2,500 honorarium, went to **Lee A. DuBridge,** president, California Institute of Technology, "for his outstanding scientific achievements in directing the Radiation Laboratory of OSRD in the field of microwave radar research, development, and application to national defense," and to **Merle A. Tuve,** of the Carnegie Institution of Washington, in recognition of his scientific contributions in making possible the proximity fuse and his administration of the various groups which equipped the Armed Forces with the device.

William F. Meggers, chief, Spectroscopy Section, National Bureau of Standards, Washington, D. C., was the recipient of the Frederick Ives Medal, presented by the Optical Society of America at its 32nd annual meeting at the Netherland Plaza Hotel, Cincinnati, Ohio, October 24.

The University of Pennsylvania has received a grant of $155,000 from the Carnegie Corporation which is to be extended over a five-year period for the support of a program of Indian and related Asian studies. The program, including both teaching and research and combining the activities of several fields and departments, will include studies of the cultural, political, social, economic, historical, anthropological, and other aspects of the national life in relation to one another and to the total character of present-day civilization in the Union of India and Pakistan. A special department to be created for administration of the program will be directed by **W. Norman Brown,** professor of Sanskrit and chairman, Department of Oriental Studies, who is now en route to India and Pakistan. The program, designed to train students in many different disciplines to apply their particular techniques to research and study of the Indian aspects of those fields, and to train them for government, business, teaching, and other types of service in India, will be in full operation by the fall of 1948.

Colleges and Universities

The University of Illinois, Division of Biological Sciences, will sponsor three lectures at Urbana by **R. Ruggles Gates,** emeritus professor of botany, University of London. The first lecture, December 1, will be on the topic, "The Evolution of Man." On December 2, Dr. Gates will deliver addresses on "Some Principles of Human Genetics" and "The Nature of Species."

The University of Chicago Cancer Research Foundation has launched a campaign to raise the funds needed to provide Chicago with a very modern and complete cancer center. The sum of $2,580,000 has already been provided for this program, including $1,600,000 for the Nathan Goldblatt Memorial Hospital and $980,000 toward the construction of a new 170-inch cyclotron. Immediate objective of the campaign is to raise the additional $570,000 necessary to complete the financing of the cyclotron, which has promise, theoretically, for deep radiation, and will be used extensively for research toward this end. It has been so designed that patients may be brought to it for treatment. Final objective is $2,000,000 for an isotope laboratory, which will be the first building designed for research with radioactive isotopes. Plans for the campaign were outlined at a civic dinner, November 10, in the ballroom of the Stevens Hotel, Chicago, at which, Charles B. Huggins, of the University of Chicago, who developed one of the first chemical tests for cancer, gave an address on "New Horizons in Cancer Research," and Enrico Fermi, Nobel Prize winner and distinguished service professor of physics at the University, spoke on "Atomic Energy—Servant of Mankind." The 1,000 guests present also heard special messages from President Truman, who was represented by his personal physician, Brig. Gen. Wallace H. Graham; Martin H. Kennelly, mayor of Chicago; and Maurice Goldblatt, president of the Cancer Research Foundation.

Iowa State College will have in operation by next spring a new food-processing laboratory, with equipment on a semi-commercial scale for research in canning, freezing, and dehydrating. The building is a two-story barracks-type which will be moved from the Ottumwa naval air base to the Iowa State campus. The processing laboratory and an evaluation laboratory for testing results will be on the ground floor. The second floor will contain an analytical laboratory, classrooms, and space for graduate students to work. Research work will be carried on by the horticulture subsection of the Iowa Agricultural Experiment Station. **E. S. Haber,** head, Department of Horticulture, and **Robert G. Tischer,** research associate professor in charge of food-processing research, will be in charge of the laboratory. The work in the new laboratory will involve cooperation with the Departments of Poultry Husbandry, Home Economics, Bacteriology, Animal Husbandry, and others.

The University of Illinois Graduate School has been renamed the Graduate College upon the recommendation of George D. Stoddard, president of the University, in recognition of the increasing importance of advanced studies. The enrollment at the Graduate College is now 2,359, an increase of 34 per cent over last year's enrollment, which in turn had been greater than all previous enrollments. **Louis N. Ridenour,** editor-in-chief of the 28-volume McGraw-Hill series of books on the wartime developments of the Radiation Laboratory at Massachusetts Institute of Technology, is dean of the Graduate College.

Cornell University has established an endowed professorship of metallurgical engineering, named after **Francis Norwood Bard,** owner of the Barco Manufacturing Company, Chicago, who presented a fund of $250,000 to endow the professorship at a dinner given in his honor. The first occupant of the new chair is **Peter E. Kyle,** of the Cornell faculty, who will also head a broadened program in metallurgical engineering, already organized in the School of Chemical and Metallurgical Engineering, which is under the over-all direction of **F. H. Rhodes,** director of the School of Chemical Engineering since its founding in 1938. The school will continue to train chemical engineers while preparing other students for responsible positions in research, development, and administration in the metallurgical industries. The new curriculum, a five-year course leading to the degree of bachelor of engineering, already has an enrollment of 27 students. The new program stems from the pioneer interest in metallurgy of the late Robert Henry Thurston, an early leader in engineering education, who placed metallurgical engineering among the most important fields of instruction and research at Cornell University.

The Institutum Divi Thomae, Cincinnati, has appointed a Clinical Advisory Committee composed of 9 physicians and scientists to act as a consulting staff in those aspects of its research which pertain to clinical medicine. In addition to Andrew C. Ivy, vice-president in charge of the Chicago Professional Colleges, University of Illinois, who is chairman of the Committee, the membership includes, E. V. Cowdry, Washington University, St. Louis, vice-chairman; Josiah J. Moore, treasurer, American Medical Association; James H. Hutton, internist and endocrinologist, Chicago; Edward C. Compere, associate professor of orthopedics, University of Illinois College of Medicine; Karl F. Meyer, director, George Williams Hooper Foundation for Medical Research, University of California; Hobart A. Reimann, professor of medicine, Jefferson Medical College, Philadelphia; William D. Stroud, professor of cardiology, Medico-Chirurgical College, Graduate School of Medicine, University of Pennsylvania; and Albert E. Casey, assistant professor of pathology, Medical College of Alabama, Birmingham. Lawrence C. Salter, Chicago, is secretary of the Committee.

The University of Washington, Seattle, has established a Department of Meteorology and Climatology, which will offer courses in physical and synoptic meteorology, meteorological laboratory, and physical and regional climatology.

Phil E. Church is acting executive officer, and **William L. Schallert**, formerly a major in the Air Forces Weather Service, is a member of the staff.

Alabama Polytechnic Institute has added four new members to its Department of Botany and Plant Pathology: **Kenneth H. Garren**, Georgia Agricultural Experiment Station; **Donald E. Davis**, Ohio State University; **Henry S. Ward, Jr.**, Iowa State College; and **James A. Lyle**, University of Hawaii Experiment Station.

Industrial Laboratories

The Kellex Corporation, atomic energy subsidiary of the M. W. Kellogg Company, has appointed as its new director of research and development **H. Hugh Willis**, formerly chief research director and vice-president, Sperry Gyroscope Company, Inc., and vice-president, Engineering and Product Development, Eversharp, Inc. Mr. Willis will be in charge of all Kellex research and development on nuclear energy and assist in certain phases of guided missiles development.

Food Research Laboratories, Inc., Long Island City, has named **Milton Blitz** assistant to the chief chemist, and has appointed **Edward Elgen**, formerly of the Quartermaster Food and Container Institute, Chicago, to the technical staff.

Meetings

At the 32nd annual meeting of the Institute of Medicine of Chicago, to be held in the Red Lacquer Room, Palmer House, on the evening of December 2, Joseph L. Baer, Rush clinical professor emeritus of obstetrics and gynecology, University of Illinois College of Medicine, will deliver the presidential address on "American Obstetrics and Gynecology: A Mature Specialty."

The American Society of Tropical Medicine, the **American Academy of Tropical Medicine**, and the **National Malaria Society** are meeting conjointly for the first time December 2–4, in Atlanta, Georgia. The meeting will feature a symposium on "The Virus Diseases in the Tropics" on the afternoon of December 3. All those interested in tropical medicine and malaria are invited to attend the meetings.

A Conference on Methods in Philosophy and the Sciences will be held December 7 at the New School for Social Research, 66 West 12th Street, New York City. The morning program will include: "History and the Philosophy of History," Maurice Mandelbaum, Dartmouth College; and "The Great Historian and the Meaning of Truth," Kurt Riezler, New School for Social Research. The afternoon session on "American Public Policy on Science" will be a Symposium on the Report of the President's Scientific Research Board, and will include the following: "Selig Hecht, 1892–1947," Leslie C. Dunn, Columbia University; "The National Planning of Science," Robert F. Steadman, Wayne University, and staff member, President's Scientific Research Board; "Scientific Freedom and National Planning," P. W. Bridgman, Harvard University; and "Science and Secrecy," James R. Newman, Yale University Law School. A discussion from the floor will follow both sessions. All those interested are invited to attend. Registration fee is $1.00.

The American Mathematical Society will hold its 54th annual meeting at the University of Georgia, Athens, December 29–31, in conjunction with the annual meeting of the Mathematical Association of America. The sessions of the Society will begin at 2:00 P. M. Monday and continue through Wednesday. The Association will meet Thursday morning and afternoon. P. M. Morse, Massachusetts Institute of Technology, will deliver the 21st Josiah Willard Gibbs Lecture on "Operational Research," on Monday at 8:00 P. M. On Tuesday at 2:00 P. M., E. F. Beckenbach, University of California at Los Angeles, will speak on "Convex Functions." There will also be an address on applied mathematics, the title and name of the speaker to be announced later. The Board of Trustees will meet on Monday, and the Council on Tuesday evening. The Annual Business Meeting and Election of Officers will be held Wednesday at 9:30 A. M.

The American Physical Society will hold its annual meeting at Columbia University, January 29–31. Programs are now being arranged by the Division of Electron Physics, the Division of Solid-State Physics, and the Committee representing the nascent Division of Fluid Dynamics. Those desiring to present papers at the meeting should submit titles and abstracts (not over 200 words) in duplicate to Karl K. Darrow, secretary, American Physical Society, Columbia University, New York 27, New York, before December 9. A maximum of 10 minutes will be allowed at the meeting for the oral presentation of a contributed paper.

The 10th annual Midwest Power Conference, sponsored by Illinois Institute of Technology, will be held April 7–9, 1948, at the Sheraton Hotel, Chicago, with Stanton E. Winston, of the Institute staff, as director. Cooperating institutions are: Iowa State and Michigan State Colleges; Northwestern and Purdue Universities; the Universities of Iowa, Illinois, Michigan, Minnesota, and Wisconsin; the Illinois section of the American Society of Civil Engineers; Illinois chapter of American Society of Heating and Ventilating Engineers; Western Society of Engineers; Engineers' Society of Milwaukee; and the Chicago sections of the American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, and American Society of Mechanical Engineers.

The American Dairy Science Association will hold its 43rd annual convention at the University of Georgia, Athens, June 14–16, 1948, making the first time the Association has met at a school farther south than the University of Kentucky. About 600 leading dairy scientists are expected to attend the meeting. The Association's president is Paul H. Tracy, professor of dairy manufactures, University of Illinois.

The Chinese Association for the Advancement of Science (formerly the Science Society of China) held its 25th annual meeting August 30–September 1 at the Academia Sinica and National Medical College of Shanghai, with the Natural Science, Astronomical, Meteorological, Geographical, Zoological, and Anatomical Societies of China participating. H. C. Zen presided over the meeting. The program included addresses by W. H. Wong, who spoke against the secrecy of scientific research and its results, and by K. C. Chu, who emphasized the utilization of scientific knowledge for peace; the presentation of papers in the various sections; and discussions among the members on "Atomic Energy and Peace" and "Improvement of Scientific Education in China."

The members of these 7 Chinese scientific societies wish to place on record their unanimous opinion with respect to (1) the control of atomic energy and (2) the development of scientific research in China:

(1) "We feel that the probing into the mysteries of atomic energy, like scientific research work in all other fields, should have as its objective the promotion of human welfare. The atomic nucleus was successfully cracked at a time when the democracies were locked in a life-and-death struggle with the totalitarian states. Quite naturally it was taken advantage of in the making of weapons of war. This is a misfortune for atomic energy and also for scientific research. Now that the war has been concluded and the democracies are endeavoring to bring about world cooperation, it is our conviction that atomic research should be freed from its closely guarded secrecy to be directed toward the advancement of world peace and welfare of the human races. We object to the application of achievements in atomic research for the manufacture of bombs and other weapons and emphatically to the competition in, or secrecy attached to, such manufacture, which threatens the friendly ties among democratic countries and jeopardizes the freedom of scientific research. Therefore we unreservedly pledge our support to the stand of the Association of Science for Atomic Education and the Federation of American Scientists.

(2) "We Chinese as a race are still facing starvation and other acute shortages in this atomic age, backwardness in the development of science being one of the causes. The significance of scientific development lies in its power to raise proportionately the standard of living. We have never before given sufficient emphasis to the fundamental sciences and cannot hope suddenly to acquire a mature status in scientific work by the importation of a few instruments for atomic studies. We must lay the foundations first by the strengthening of the physical equipment for science education and by extending adequate facilities and stable living conditions to our teaching and research personnel. What is more important, we should adopt a definite and long-range plan for the development of scientific undertakings with the necessary budgets to carry it out to the fullest extent. The discontinuation of the YVA project shortly after its inception is an example that we hope will not be repeated. If we want science to serve as an important contributing factor in the reconstruction of the nation, we believe it must be made to stand on firmer ground. Scientific development cannot be bought ready made, as some people thought half a century ago that it could be in the form of firearms and gunboats."

Elections

United Engineering Trustees, Inc., at its annual meeting October 23 in the Engineering Societies Building, 29 West 39th Street, New York, elected J. Schuyler Casey, president, M. H. Treadwell Company, Inc., New York, as president; Gen. William H. Harrison, chief engineer, American Telephone and Telegraph Company, New York, and director, Procurement and Distribution Service, Office of Chief Signal Officer, Washington, D.C., as vice-president; Edward C. Meagher, assistant to the president, Texas Gulf Sulphur Company, New York, as vice-president; Kurt W. Jappe, retired director of purchases, Hercules Powder Company, Wilmington, Delaware, as treasurer; James L. Head, Department of Mines, Chile Exploration Company, New York, as assistant treasurer; and John H. R. Arms was re-elected secretary.

At the 20th annual meeting of the Texas Archaeological and Paleontological Society, October 25, Cyrus N. Ray, Abilene, Texas, was elected president for the 20th consecutive year; Tom N. Campbell, Austin, was elected vice-president; Earnest Wallace, Lubbock, secretary-treasurer; and W. C. Holden, Lubbock, editor of publications. Other officers elected included Alex Krieger, Austin, Rupert N. Richardson, Abilene, and Joe Ben Wheat, Tucson, Arizona, as directors, 8 regional vice-presidents, and 8 trustees.

The Ohio Branch, Society of American Bacteriologists, elected the following officers at its Autumn Conference October 25 on the Ohio State University campus: Orton K. Stark, Miami University, president; John Dingle, Department of Preventative Medicine, Western Reserve University, vice-president; and H. H. Weiser, Department of Bacteriology, Ohio State University, secretary-treasurer. Robert Parker, College of Medicine, Western Reserve University, was elected consular to the Society of American Bacteriologists, and Lloyd C. Ferguson, Department of Bacteriology, Ohio State University, member of the Policy Committee.

The Engineering Foundation, at the annual meeting of its Board, October 16, in the Engineering Societies Building, New York, elected as officers for the coming year: A. B. Kinzel, vice-president, Union Carbide and Carbon Research Laboratories, Inc., chairman; L. W. Chubb, director, Westinghouse Research Laboratories, vice-chairman; Edwin H. Colpitts, formerly vice-president, Bell Telephone Laboratories, director; and John H. R. Arms, secretary. Newly appointed to the Executive Committee were: George L. Knight, formerly vice-president, Brooklyn Edison Company; and Joseph W. Barker, president, Research Corporation.

NRC News

The name "Committee on Aviation Psychology" has been substituted for "Committee on Selection and Training of Aircraft Pilots" to designate a committee of the Division of Anthropology and Psychology which has conducted research in the field of aviation psychology since 1939. As in the past, the work of the Committee is supported with funds allotted by the Civil Aeronautics Administration, although steps have recently been initiated to undertake research for other government agencies.

The Committee has from its very beginning conducted research involving the maintenance as well as the selection and training of aircraft pilots. Among the more than 70 reports published by the Committee in the Technical Series, Division of Research, Civil Aeronautics Administration, there are many which are concerned with the psychological aspects of fatigue, accidents, air sickness, etc. The change in name, which has been under consideration for some time, has been made in order to describe Committee functions more accurately.

The current research program of the Committee on Aviation Psychology, which is largely concerned with air transport pilots and, most particularly, with human factors in airplane accidents, includes research on the selection, upgrading, and certification of pilots; studies of stall-warning devices; psychological aspects of instrumentation; and investigation of methods of training civilian and commercial pilots. Such research is being conducted through The Ohio State University, the American Institute for Research, the Educational Research Corporation, and other agencies. The Executive Subcommittee will be pleased to consider proposals for grants-in-aid to research personnel working in universities and other institutions who are interested in carrying out investigations in the field of aviation psychology under the auspices of the Committee. Proposals should be submitted to: M. S. Viteles, Chairman, National Research Council Committee on Aviation Psychology, University of Pennsylvania, Philadelphia, Pennsylvania.

The present membership of the Committee includes: Brigadier Gen. Milton W. Arnold, vice-president, Operations & Engineering, Air Transport Association of America; Cdr. Norman L. Barr, Division of Aviation Medicine, Bureau of Medicine & Surgery, Navy Department; George K. Bennett (*ex officio*), president, Psychological Corporation; D. R. Brimhall, assistant to the Administrator for Research, CAA; Paul M. Fitts, chief, Psychology Branch, Aero Medical Laboratory, Wright Field; Frank A. Geldard, professor of psychology, University of Virginia; Capt. B. Groesbeck, Division of Aviation Medicine, Bureau of Medicine & Surgery, Navy Department; Major Gen. Malcolm C. Grow, Air Surgeon, Army Air Forces; George E. Haddaway, editor, *Southern Flight*, Air Review Publishing Corporation; A. I. Hallowell (*ex officio*), chairman, Division of Anthropology and Psychology, and professor of anthropology, University of Pennsylvania; J. G. Jenkins, head, Department of Psychology, University of Maryland; Capt. Wilbur E. Kellum, U. S. Navy, School of Aviation Medicine, Pensacola, Florida; Peter C. Kronfeld, associate professor of ophthalmology, and director of education, Illinois Eye and Ear Infirmary, University of Illinois; Jerome Lederer, chief engineer, Aero Insurance Underwriters; Donald B. Lindsley, professor of psychology, Northwestern University; W. R. Miles, professor of psychology, School of Medicine, Yale University; C. L. Shartle, professor of psychology, The Ohio State University; Lt. Col. Anthony C. Tucker, Office of the Air Surgeon, Headquarters, Army Air Forces; and M. S. Viteles (chairman), professor of psychology, University of Pennsylvania.

Cdr. Barr, Drs. Bennett, Brimhall, Fitts, Geldard, Hallowell, Lindsley, and Viteles, and Capt. Kellum and Lt. Col. Tucker make up the Executive Subcommittee.

Recent Deaths

Erik Lysholm, 55, Swedish radiologist who produced the first "precision skull apparatus" and who also contributed the so-called "fixed" or "Swedish grid," died in Stockholm September 26.

Mrs. David R. Merrill, 52, died October 8 at Burlington County Hospital, Mt. Holly, New Jersey.

George W. Wilson, 57, dean, Marquette University Dental School, died in Milwaukee November 11, after a long illness.

Clovis Vincent, 68, chief, Neurosurgical Services, Pitie Hospital, Paris, France, and a noted brain surgeon, died November 14.

George Grant MacCurdy, 84, professor emeritus of anthropology, Yale University, and retired director, American School of Prehistoric Research, Washington, D. C., was fatally injured November 15, when he was struck by an auto while crossing the road on Route 29, near North Plainfield, New Jersey.

William M. Malisoff, 52, director, Longevity Research Foundation, New York City, and formerly associate professor of biochemistry, University of Pennsylvania, and Brooklyn Polytechnic Institute, died November 16 at his New York home after a day's illness. Dr. Malisoff had edited *Philosophy of Science* since 1934.

A Mission on Science and Technology will soon be established in the U. S. Embassy in London. According to a joint White House and Department of State release, the Mission staff will be a small one, headed by **Earl A. Evans, Jr.,** chairman, Department of Biochemistry University of Chicago. These scientists and engineers will be assigned for short-term periods on a rotating basis. Main duty of the Mission will be to supply to interested individuals and agencies in Great Britain information concerning current developments in such fields as organic chemistry, biochemistry, physics, engineering, biology, and agronomy, and to collect similar information on British developments for dissemination to government agencies and scientific societies in this country. Specifically, the Mission will also assist in facilitating exchange of scientific personnel, develop and continue close personal contact with government agencies and research institutions in the United Kingdom, answer inquiries about particular developments in Great Britain originating in this country, and stimulate exchange of reports of a scientific and technical nature. Such an arrangement was recommended by John R. Steelman, special assistant to the President, in his series of reports entitled *Science and public policy*. The British have for some time maintained in the United States the British Commonwealth Scientific Office, which has proved extremely successful. In a letter to the Rt. Hon. Herbert Morrison, Lord President of the Council, London, dated October 30, Mr. Steelman, in announcing the proposed establishment of the Mission, stated that "an exchange of ideas and information, in accordance with the freedom that has always characterized the relations between scientists in our two countries, should result in substantial benefits not only to specialists in the fields of science, medicine, and engineering, but to all citizens in both our Nations."

The Committee on Russian Literature of the Geological Society of America has begun the compilation of a list of translations of geologic papers and books from Russian into English—that is, a list of translations extant in manuscript form in the United States. The readers of *Science* are requested to send information concerning any such translations to the committee chairman, Ronald K. DeFord, Box 1814, Midland, Texas, or to Geological Society headquarters, 419 West 117th Street, New York 27, New York. The word *geologic* is used here in its widest sense to extend inclusively from geophysics to paleontology.

If information about translations of *recent* publications is received soon enough, it will be included in forthcoming volumes of the *Bibliography and index of* *geology exclusive of North America* and the *Bibliography of economic geology*, subject to permission from proprietors of translations.

The National Applied Mathematics Laboratories, which sprang from the realization by the Office of Naval Research in 1946 of an urgent need for a national center where facilities and staff would be available to develop and use new high-speed computing machines in service to the field of applied mathematics, has now been established as a division of the National Bureau of Standards. The center is headed by **John H. Curtiss,** formerly director's assistant in applied mathematics at the Bureau. The work of the new division, concentrating on mathematical statistics as applied to the physical and engineering sciences, will be carried on with the advice of an Applied Mathematics Council made up of representatives from interested government agencies and private organizations.

Within the new center are four separate laboratories: the Institute of Numerical Analysis, on the campus of the University of California at Los Angeles, which, under the auspices of the Office of Naval Research, will do research and training in mathematical fields best suited to the use and development of high-speed automatic digital computing machines, and also provide computing service for local groups; the Computation Laboratory, headed by **Arnold N. Lowan,** formerly technical director, Mathematical Tables Project, and also underwritten by ONR, which will continue the work of the Mathematical Tables Project and provide a computing service for use by private industry, government agencies, and educational and research institutions; the Statistical Engineering Laboratory, headed by **Churchill Eisenhart,** formerly senior staff member, Statistical Research Group, Columbia University, which will provide a consulting service on methods of statistical inference as applied to engineering and physical sciences for government and private agencies, and training in the theory of statistics; and the Machine Development Laboratory, headed by **E. W. Cannon,** statistical engineering officer, Bureau of Ships, which will develop and construct the new computing machinery according to the specifications set forth by the other laboratories, the Office of Naval Research, the Bureau of the Census, and other government agencies.

The carnivorous Army Ants will be the subject of a study by a field group which left the American Museum of Natural History for Panama, November 4. **T. C. Schneirla,** curator, Department of Animal Behavior of the Museum, who heads the expedition, was accompanied by **Ernest Enzmann,** research associate in zoology, Massachusetts Institute of Technology, and **Robert Z. Brown,** graduate student of zoology, Swarthmore College. The group will spend 5 months on Barro Colorado Island in Gatun Lake and in the Darien country of eastern Panama. The Army Ant derives its name from its highly military society; it moves in colonies of 65,000 and more in long, narrow columns sometimes stretching out 300 yards. The ants move in regular cycles traveling nightly for 17 days and resting for 20. When on the move, they send out flanking columns for scouting and food securing. The field group hopes to discover how the ant colony queens are formed, and how and why the queen ants possess the ability to produce broods at regular intervals of 36 days throughout the year, all of these broods but one consisting of about 30,000 nonreproductive workers; the remaining brood consists of about 3,000 males born in the dry season. A brood containing queens may prove to be another exception.

From the waste pulp of the coffee bean comes a new corn-substitute cattle feed for milk production, developed through the cooperative effort of agricultural technicians of the United States and El Salvador. Tests under specific conditions have proved that the coffee pulp can be substituted, pound for pound, for corn as cattle feed for milk production. Coffee pulp is the fleshy covering of the bean and is largely a waste product, and although it has limited use as a fertilizer, its disposal has usually been a problem. In recent years the potential value of coffee pulp as a feed has been recognized by **Felix Choussy,** Instituto Tecnologico, El Salvador, and **R. L. Squibb,** formerly of the Inter-American Institute of Agricultural Science. Studies regarding the substitution of dried coffee pulp for corn in the ration of milk cows were conducted in El Salvador by **Samuel H. Work,** Office of Foreign Agricultural Relations, and **Mario Lewy Van Severen,** chemist, and **Louis Escalon,** dairying technician, El Salvador. It has been found that the palatability of the pulp is increased by mixing it with banana leaves, molasses, or other feedstuff. Additional tests will be made at the U.S. Department of Agriculture's research center, Beltsville, Maryland, and at various other state experiment stations.

Marine life in the Bikini lagoon appears little changed by the atomic bomb radiations, according to the observations of **Leonard P. Schultz,** curator of Fishes, Smithsonian Institution, who has just returned from Bikini after taking part in the Bikini Scientific Resurvey carried out by the Navy Department in cooperation with the Army and other government agencies. Dr. Schultz explained that undoubtedly enormous numbers of fish and other marine organisms were killed by the bomb explosion, but their places have been filled by overpopulation pressure from outside the immediate explosion area, with the result that life seems about as abundant as ever. There was no observable sterility caused by the continued radioactivity, as various specimens were found spawning in normal fashion. Genetic effects or possible weaknesses from continued radiation are impossible to discern at this early date.

Make Plans for—

American Academy of Pediatrics, annual meeting, December 9, Dallas, Texas.

National Council of Geography Teachers, December 27–29, Charlottesville, Virginia.

American Society for Professional Geographers, December 27–30, Charlottesville, Virginia.

American Anthropological Association, December 28–31, Albuquerque, New Mexico.

American Astronomical Society, December 28–31, Ohio State University, Columbus, Ohio.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

Chemical Structure and the Definition of Sympathin E[1]

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Cannon (*2*), in 1940, had come to the conclusion that the chemical substance liberated from sympathetic (adrenergic) nerves and responsible for activating the effectors they innervate was, indeed, as Elliott (*4*) had speculated and Loewi (*8*) has long claimed, adrenaline and identical with the secretion of the adrenal medulla.

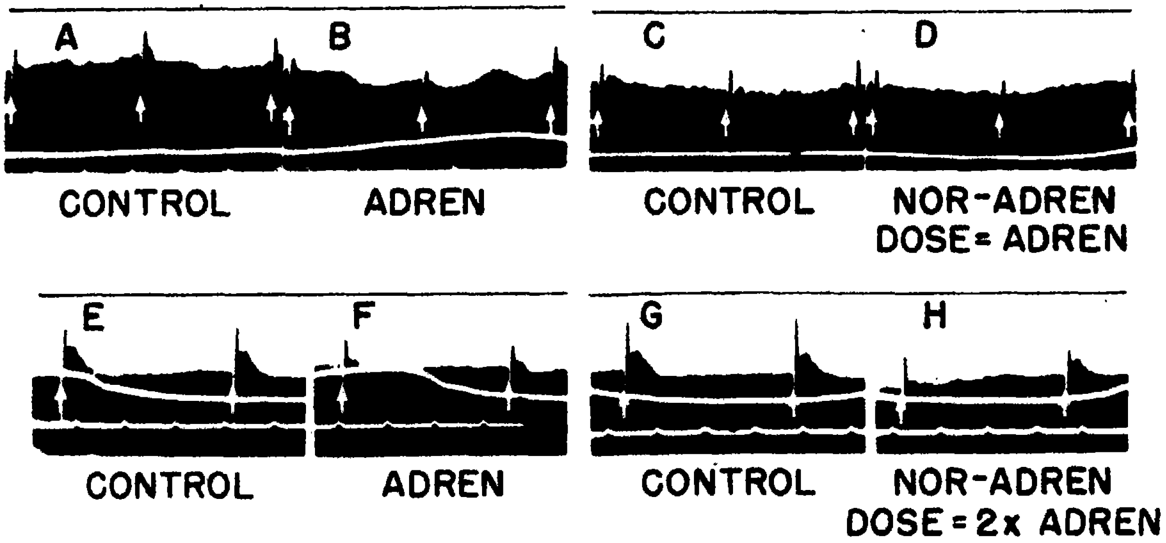

Fig. 1. Comparison of ganglionic inhibitory activity of adrenaline and nor-adrenaline.

Cannon and Rosenblueth (*3*) had previously demonstrated that the substance liberated by adrenergic nerves was further elaborated in the effectors and that, under conditions of excessive stimulation, the new product formed overflowed and appeared in the blood stream as a substance possessing either *purely* excitatory or *purely* inhibitory properties, depending on whether it was formed in an excited or an inhibited effector. In this manner they defined sympathin E and sympathin I.

Since the sympathins are derived in the first instance from the adrenaline (or adrenaline-like substance, cf. Euler, *5*) liberated from nerves but possess only a part of adrenaline's actions, many hypotheses have been advanced as to the composition and manner of formation of the degradation product. Demethylated adrenaline (nor-adrenaline) has been a favorite candidate for the role of sympathin E (*1*, *5*, *6*, *7*).

In studying the relation of chemical structure to the action of sympathomimetic amines we have found it necessary to develop a more discriminating and sensitive method than has been available for the quantitative determination of the inhibitory properties (*12*). For this purpose we have utilized the inhibitory effect of sympathomimetic amines on transmission at synapses in sympathetic ganglia described by one of us in 1939 (*10*, *11*). We have recently emphasized that in these effects we are dealing with an initial and primary adrenergic inhibition and not some sequela of excitation (*13*).

Synaptic transmission was maintained at a control level by applying electrical stimuli of constant intensity to the preganglionic nerves and recorded by registering the resulting postsynaptic action potentials from the postganglionic nerves by suitable high-gain amplifiers (*9*). With the ganglionic circulation intact, a drug injected intravenously readily gains access to the ganglionic synapses and manifests its inhibitory effect by a reduction in the height of the postsynaptic potentials.

In this way, as illustrated in Fig. 1 B and D, which show the effects of intravenously injected equimolar quantities of adrenaline and nor-adrenaline[3] on the superior cervical sympathetic ganglion of the cat anesthetized with nembutal,[4] it can readily be seen that nor-adrenaline has a considerable inhibitory effect, in fact, as much as one-half the inhibitory power of adrenaline (F, H). Since these synapses are adrenergic—and furthermore can fairly be considered as representative of adrenergic junctions in general (*12*)—this disqualifies nor-adrenaline from being sympathin E unless we depart from Cannon and Rosenbleuth's definition of sympathin E as a *purely* excitatory substance without inhibitory action. We must conclude, therefore, that neither nor-adrenaline nor any of the other sympathomimetic amines in the series of 21 compounds we have studied in this fashion (to be reported in detail elsewhere) can be sympathin E. An alternative would be to regard sympathin E as a substance that is only predominantly rather than purely excitatory.

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[1] This research was conducted with the assistance of a grant-in-aid from the U. S. Public Health Service.

[2] Smith, Kline & French fellow.

[3] We wish to thank C. M. Greer for supplying us with nor-adrenaline.

[4] Nembutal was kindly furnished by Abbott Laboratories.

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Microbial Utilization of Carcinogenic Hydrocarbons[1]

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Recent investigations reveal that microorganisms of marine origin may be capable of decomposing carcinogenic hydrocarbons associated with the production of tumors in animals.

That many microorganisms possess the ability of utilizing hydrocarbons as a sole source of energy in their metabolism has been previously demonstrated and confirmed (*2*). Nearly 100 species of bacteria, yeasts, and molds representing 30 genera have been shown to attack various hydrocarbons of the gaseous, liquid, and solid state, and in the aliphatic, olefinic, naphthenic, and aromatic series. Such organisms have been found widely distributed in nature, from terrestrial as well as marine sources. The list of hydrocarbons which have been found to be subject to microbial attack is rapidly growing.

The current studies on microbial utilization of carcinogenic hydrocarbons are incidental to a comprehensive survey of the role of bacteria in the decomposition and diagenesis of petroleum hydrocarbons and related compounds. However, the widespread interest in cancer research and the obvious need for mutual cooperation among all scientific workers who may be concerned, directly or indirectly, with such a vital problem relating to public health suggest that these findings be presented apart from those pertaining to petroleum genesis.

Included among the compounds used as substrates were naphthalene, anthracene, phenanthrene, diaminobenzene, 1,2-benzanthracene, and 1,2,5,6-dibenzanthracene. The latter two are listed in a recent survey published by the U. S. Public Health Service (*1*) as having induced tumors in experimental animals. Like the majority of the carcinogenic compounds listed in this survey, the 6 which were investigated are aromatic cyclic or polycyclic hydrocarbons containing one or more benzene rings, (Fig. 1). Chemically and physically they are stable and refractory compounds with low solubilities or, as is the case with 1,2-benzanthracene and 1,2,5,6-dibenzanthracene, insoluble in water and the organic solvents commonly used in the laboratory.

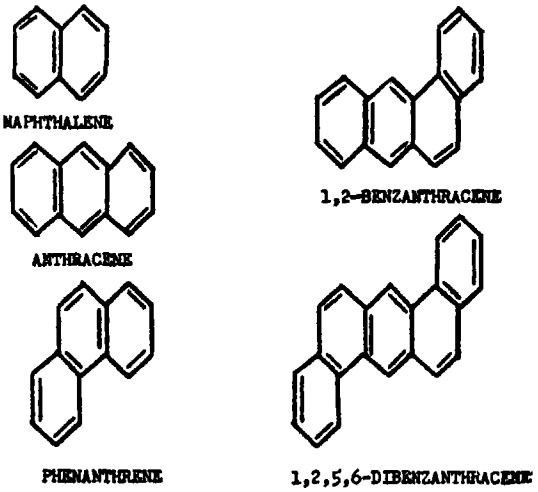

Fig. 1

The organisms used in the experiments were of marine origin. For the purpose of demonstrating the utilization of the carcinogenic and related hydrocarbons by the cultures, an apparatus was employed which measured the amount of carbon dioxide evolved by the cultures upon oxidation of the substrate. Other methods for determining the rate of oxidation have been successfully used, however, including the measurement of oxygen uptake, both manometrically and by the Winkler method (*3*).

The 6 compounds tested were dispersed in ignited sand to provide suitable surface area for the organisms. Two of the compounds, 1,2-benzanthracene and 1,2,5,6-dibenzanthracene, which are solid compounds at room temperatures and insoluble in water and organic solvents, were ground to a fine powder in a mortar, which favored a more intimate contact between the organisms and the substrate. Naphthalene, anthracene, and phenanthrene were first dissolved in volatile solvents and then precipitated as a thin film on ignited sand by evaporating off the solvent.

After the ignited sand and substrate were added to the culture receptacles, the only additional substance used besides the inoculum was the suspension medium. For this purpose, filtered sea water containing 0.1 per cent $(NH_4)_2HPO_4$ was used. This had been previously aged for several months in the dark at a temperature favoring the removal of dissolved organic matter present. Sea water is a physiologically balanced solution and contains all the essential salts necessary to satisfy the mineral requirements of marine organisms.

The controls used in these experiments included, for the most part, those which precluded false positive readings which might result from the possible introduction of adventitious organic matter in the substrate, inoculum, suspension medium, glassware, and connections in contact with the incubating cultures, plus controls to measure endogenous metabolism. The cultures, together with 25 mg. of hydrocarbon substrate, ignited sand, and sea water, were incubated at 32° C. for four days with the controls, during which time a stream of carbon dioxide-free air was bubbled through the culture receptacles at the rate of 50 ml./minute. The carbon dioxide evolved from the oxidation of the substrate and from endogenous metabolism was collected in N/10 NaOH during the incubation period. The residual carbon dioxide remaining in the solution after incubation was driven off by acidification. The endogenous control served also to eliminate the effect of carbon dioxide (as dissolved carbon dioxide, bicarbonate, and carbonate) present in the sea water other than that evolved by metabolic processes, which would be flushed into the caustic solution upon acidification.

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[1] Contribution from the Scripps Institution of Oceanography, New Series 348. This paper is a contribution from the American Petroleum Institute, Research Project 43A.

The carbon dioxide collected at the receiving end of the apparatus was determined by back titration. That produced by the endogenous control was subtracted from the total carbon dioxide produced by the culture acting on the substrate to give the net amount of hydrocarbon oxidized by the organisms (Table 1). Since the empirical formulas and molecular weights of the hydrocarbons under test are known, the per cent oxidation of 25 mg. of the substrate was computed.

TABLE 1

AMOUNT OF CARBON DIOXIDE PRODUCED BY ACTION OF BACTERIA ON 25 MG. OF HYDROCARBONS IN FOUR DAYS AT 32° C.

Hydrocarbon	CO_2 produced (mg.)	Amount oxidized (%)
Naphthalene	44.2	51
Anthracene	53.5	64
Phenanthrene	58.5	68
Diaminobenzene	14.0	23
1,2-Benzanthracene	41.2	47
1,2,5,6-Dibenzanthracene	11.6	13
None (Control)*	0	—

* The controls used as checks against introduction of adventitious organic matter produced less CO_2 than the endogenous controls, hence are condensed as one control shown here.

In view of the high oxidation rates, it does not seem unlikely that a quantitative oxidation of the carcinogenic hydrocarbons could be effected with a longer incubation period.

It is not contemplated that current investigations of the microbial utilization of carcinogenic hydrocarbons will continue beyond a brief survey of those compounds of particular structural interest. The findings from these cursory investigations have been presented with the hope of stimulating further research into the possible application of bacteria or their products in the prophylactic or therapeutic treatment of cancer.

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Effect of Indole on the Determination of N'-Methylnicotinamide

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The fluorometric method for determining the amounts of N'-methylnicotinamide in urine, which has been widely used, has been particularly valuable for measurements of N'-methylnicotinamide in the urine after the test animal has been fed tryptophane or related compounds (e.g. *4, 5, 6, 8*). In studies conducted in our laboratory (*6, 7*) measurements of N'-methylnicotinamide have been carried out without hydrolysis of the urine samples by the method of Huff, *et al.* (*2*). During the course of investigations on the effect of vitamin B_6 deficiency on the apparent conversion of tryptophane to nicotinic acid, it was of interest to determine the influence of feeding indole to rats on the amounts of N'-methylnicotinamide and nicotinic acid excreted in the urine.

TABLE 1

EFFECT OF FEEDING INDOLE TO RATS ON MEASUREMENT OF N'-METHYLNICOTINAMIDE AND NICOTINIC ACID IN THE URINE

(Values expressed as μg. excreted/rat/day)

Experimental series	Feeding regimen for indole					
	Before	During	After	Before	During	After
	N'-Methylnicotinamide			Nicotinic acid		
A	335	597	281	37	10	27
B	71	380	81	25	27	39
C	78	523	67	33	40	32
D	63	450	70	39	37	41
E	80	323	55	37	36	49
F	400	630	243	34	62	52
G	191	351	135	30	12	18
H	—	273	159	36	15	23
Average	194	448	152	33.8	25.9	32.6

When a purified ration, adequate in vitamin B_6 but devoid of added nicotinic acid, was fed, the rats fed 100 mg. of dl-tryptophane/day excreted large amounts of N'-methylnicotinamide and nicotinic acid (*6*). However, when the rats were fed 50 mg. of indole/per day, a definite, though smaller, rise in N'-methylnicotinamide, but no increase in the amount of nicotinic acid, was observed. In fact, a slight reduction was noted in the average amount of the latter excreted (Table 1). This observation can be explained partially on the basis of a lower food consumption during the period when indole was added to the ration. In this work the same experimental regimen and analytical procedures were used as in earlier work (*6*).

These observations and those obtained on the ineffectiveness of indole in stimulating the growth rate of rats fed rations low in nicotinic acid (*3*; unpublished data) suggested that indole was not being utilized to form nicotinic acid derivatives, but was interfering with the fluorometric determination of N'-methylnicotinamide. To test this possibility, samples of urine from rats fed indole were extracted with ether to remove indole and some related compounds (*1*) prior to the estimation of

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[1] The technical assistance of Patricia Sparks is gratefully acknowledged.

N′-methylnicotinamide. In addition, the effect of indole, tryptophane, and anthranilic acid on the measurement of N′-methylnicotinamide was determined, and the effect of indole was also tested in the presence and absence of urine. Some of these results are shown in Table 2.

Indole tested in the absence of urine showed some fluorescence measured as N′-methylnicotinamide. The fluorescence observed was equivalent to 12.2, 9.0, and 6.0 μg. of N′-methylnicotinamide when 1,000, 750, and 500 μg. of indole were tested. This effect could be eliminated by ether extraction of the indole solutions prior to the estimation of N′-methylnicotinamide. Anthranilic acid or tryptophane failed to show this interference, in that no fluorescence was observed when 1 mg. or more of these compounds was tested. It is readily apparent, therefore, that indole does interfere with the determination of N′-methylnicotinamide to a small extent, and this effect can largely be eliminated by the ether extraction procedure. Ether extraction of urine from rats fed indole reduced the values for N′-methylnicotinamide somewhat (Table 2), but did not reduce them to an extent whereby the effect of feeding indole on the amounts of the methylated derivative found in the urine was negated. Control tests conducted with urine from rats fed the basal diet or basal diet plus tryptophane showed no reduction attributable to ether extraction of the samples. Similarly, N′-methylnicotinamide was not extracted by ether. Thus, it appears that extracting urine samples with ether removes only a portion of the interfering substances formed when indole is fed. The possibility, however, that when indole is fed some increase does occur in the amount of N′-methylnicotinamide excreted cannot be unequivocally ascertained. Furthermore, the large increases noted in the amounts of N′-methylnicotinamide and other nicotinic acid derivatives excreted when tryptophane is fed may be due, to a slight extent, to the presence of interfering compounds in the urine not extractable by ether. This possibility has also been recognized by other workers (*8*). No evidence has been obtained to suggest that indole or related compounds interfere with the microbiological determination of nicotinic acid. These observations indicate that the significance of the small rise noted in the amounts of N′-methylnicotinamide excreted when indole was fed is questionable.

TABLE 2

EFFECT OF INDOLE ON THE APPARENT URINARY EXCRETION OF N′-METHYLNICOTINAMIDE BY THE RAT

(Values expressed as mg./ml. of urine)

Urine collection (No.)	Diet fed	Apparent excretion of N′-methylnicotinamide	
		Not ether extracted	Ether extracted
58	Basal ration	1.87	1.81
65	" "	4.02	4.00
66	" "	3.68	3.68
47	Basal + 50 mg. of indole/day	3.59	3.08
48	" " " " " " "	2.94	2.41
51	" " " " " " "	4.90	4.52
52	" " " " " " "	6.70	6.65
24	Basal ration + 100 mg. of dl-tryptophane/day	21.6	20.9
25	" "	20.1	19.8
26	" "	16.9	17.2
27	" "	16.2	17.9
24a	Basal ration + 100 mg. of dl-tryptophane/day + indole*	25.4	22.7
25a	" "	23.6	20.2
26a	" "	16.9	16.3
27a	" "	19.0	17.3

* In these tests 40 μg. of indole were added to each ml. of urine prior to estimations of N′-methylnicotinamide in each sample with and without ether extraction.

Further work in identifying urinary nicotinic acid metabolites and refinements in methods for their estimation will be helpful in elucidating the metabolism of nicotinic acid and its relationship with other dietary nutrients.

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Production of Starch-like Material From Glucose-1-phosphate by Diphtheria Bacilli[1]

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This paper deals with the production of starch-like material from glucose-1-phosphate by *Corynebacterium diphtheriae* and some streptococci. The occurrence of starch-phosphorylases in yeast and in plant and animal tissues is well known, but, apart from our observation (*1*) that some strains of *Neisseria perflava* which form an amylopectin-like material from sucrose also form small amounts from glucose-1-phosphate, the capacity of bacteria to convert glucose-1-phosphate to products of the starch class has not previously been reported.

The bacteria tested in the present experiments included 17 strains of *C. diphtheriae* (12 had been recently isolated), 12 strains of streptococci Lancefield groups A to F, 9 strains of streptococci from endocarditis which form dextran from sucrose (*2*), and representatives of various other species of medical interest; for purposes of comparison, 3 strains of *N. perflava* were also included. The bacteria were inoculated into 3 mediums containing 2 per cent glucose-1-phosphate (crystalline dipotassium salt), 2 per cent glucose, or 2 per cent sucrose; the base was 1 per cent tryptose, 0.3 per cent yeast extract, 0.5 per cent NaCl, and 0.05 per cent glucose; for the meningococci and gonococci, 0.2 per cent agar was added. After incubation at 37° C. for 7 days, the cultures which had good growth in all the mediums were centrifuged, and the supernatant fluids and the bacterial sediments were tested separately for starch-like material by observation for dark coloration upon addition of a solution containing 0.02 per cent I_2 and 0.2 per cent KI.

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[1] This work was aided by a grant from the Sugar Research Foundation, Inc.

The chief point (Table 1) is that all the strains of *C. diphtheriae* produced material which gave a dark-blue to purple color with iodine when grown in the medium containing glucose-1-phosphate; the iodine-coloring material was readily demonstrable in the supernatant fluids as well as in the bacterial sediments. The same capacity was shown by some of the streptococci, but it did not occur regularly among the varieties which we tested; for example, only one of 5 group A, 2 of 3 group C, and 2 of the 9 dextran-forming streptococci gave a positive reaction. Except for the *N. perflava*, none of the other bacteria tested produced any detectable amount of iodine-coloring material, but the number of strains included are too small to warrant any conclusions on the entire lack of the capacity in any of those species. That all the 17 strains of *C. diphtheriae* and none of the 3 diphtheroids which we tested had the capacity raises the question of the possible use of tests for the production of starch-like material from glucose-1-phosphate as a descriptive, and perhaps as a differential, feature for *C. diphtheriae.*

TABLE 1

TESTS ON CULTURES GROWN IN BROTHS CONTAINING GLUCOSE-1-PHOSPHATE, GLUCOSE, OR SUCROSE

Bacteria	No of strains tested	Dark color with iodine*		
		GP	G	S
C. diphtheriae	17	17	0	0
Streptococcus, groups A–F	12	4	0	0
" , others†	9	2	0	0
Other bacteria‡	40	0	0	0
N. perflava	3	1	0	3

* GP = glucose-1-phosphate; G = glucose; S = sucrose.

† Strains from subacute bacterial endocarditis which form dextran from sucrose (*2*).

‡ Included 3 diphtheroids, 3 staphylococci, 7 gonococci, 2 meningococci, 3 *E. typhosa*, 2 *Salmonella*, 3 *Shigella*, 1 *Bact. coli*, 2 *Bact aerogenes*, 2 *Bact. Friedlanderi*, 2 *Proteus*, 1 *Ps. pyocyanea*, 1 *Cl. tetani*, 1 *Cl. histolyticum*, 2 *B. anthracis*, and 5 *B. subtilis*.

The formation of starch-like material by *C. diphtheriae* apparently belongs to the same general class of reactions as those brought about by the starch-phosphorylases of tissue origin. As shown in Table 1, glucose-1-phosphate serves as substrate, and sucrose and glucose do not. Furthermore, in experiments which we have made with mixtures of resting cells plus glucose-1-phosphate, formation of polysaccharide occurred and was accompanied by an increase in inorganic phosphate and a corresponding loss in organic bound phosphate; also, the polysaccharide production was inhibited by high concentrations of inorganic phosphate. Although its chemical study has not been completed, the bacterial product has been found to be a mixture of amylose-like and amylopectin-like polysaccharides, and in that respect it can be regarded as a material similar to the starches formed by many plants.

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Vitamin Requirements of *Microbacterium lacticum* Orla-Jensen

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Investigations in progress on the metabolism and taxonomic position of bacteria in the genus *Microbacterium* Orla-Jensen (*1*) have shown that d-calcium pantothenate constitutes an essential nutritional requirement for some strains of *Mbm. lacticum*. In addition, thiamine was identified as one of the vitamins exerting a stimulatory effect upon growth.

TABLE 1

COMPOSITION OF BASAL MEDIUM

Glucose, c.p.	1.0 gram
Casein hydrolysate, vitamin-free	0.5 "
K_2HPO_4, c.p.	0.2 "
KH_2PO_4, c.p.	0.2 "
d-Calcium pantothenate	100.0 γ
Thiamine hydrochloride	100.0 γ
Distilled water to make	100.0 ml.
pH 6.6 ± 0.1	

Preliminary experiments indicated that several strains of *Mbm. lacticum* would grow in a mediun consisting of inorganic salts, glucose, vitamin-free hydrolyzed casein,[1] and a combination of most of the known bacterial vitamins. By a process of elimination it was found that a medium of the composition listed in Table 1 and designated as the basal medium would support growth of most strains tested.

TABLE 2

EFFECT OF D-CALCIUM PANTOTHENATE AND THIAMINE ON THE GROWTH OF *Mbm. lacticum*

Composition of medium	Strain designation						
	0J3	1PM1	1PM3	3RM2	3RM3	8180	S2
Basal minus d-Ca pantothenate and thiamine	0*	0	0	0	0	0	0
Basal minus d-Ca pantothenate	0	0	0	0	0	0	0
Basal minus thiamine	16	30	29	22	25	19	6
Basal medium	29	40	44	41	46	38	40

* Percentage of light absorbed through 10 ml. of medium measured with a Fisher Electrophotometer AC model, using filter 425 (blue). Readings after 4 days at 30° C.

A solution of the vitamin-free casein hydrolysate, neutralized to pH 6.6 ± 0.1, and solutions of glucose and phosphate salts were prepared and sterilized individually by autoclaving 15 minutes at 121° C. The d-calcium pantothenate and thiamine hydrochloride were sterilized individually by filtration through a Jena 1G5 auf 3 glass filter. Appropriate volumes of these ingredients were mixed together and then added to sterile test tubes in 10-ml. amounts, so that the final concentrations were as indicated in Table 1.

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[1] A vitamin-free hydrolyzed casein designated as Lot #6 and obtained through the courtesy of M. L. Speck, National Dairy Research Laboratories, Baltimore, Maryland.

The inoculum for the basal medium was prepared in the following manner: Five ml. of a 4-day culture grown in yeast-extract-proteose-peptone-glucose broth (30° C.) was centrifuged and the sedimented cells washed with 5 ml. of 0.85 per cent saline. This was again centrifuged and the cells resuspended in 5 ml. of 0.85 per cent saline. One loopful of this suspension served as the inoculum for 10 ml. of basal medium. Ten of 14 strains of *Mbm. lacticum* were capable of growing on repeated subculture in the medium described in Table 1. The 4 strains which did not grow in this medium also failed to grow when most of the known bacterial vitamins were supplied.

Further observations indicated that d-calcium pantothenate was absolutely essential for the initiation of growth. Thiamine hydrochloride, however, was not. The 10 strains which grew in the basal medium also grew, though rather poorly, when thiamine hydrochloride was omitted. The effect of elimination of d-calcium pantothenate and thiamine hydrochloride separately and together on several representative strains is shown in Table 2.

The typical growth response of 4 strains of *Mbm. lacticum* to graded amounts of d-calcium pantothenate after 4 days at 30° C. is presented in Fig. 1. The minimal amount of this compound necessary for initiation of growth for most strains studied was approximately 0.02γ/ml., and maximum effect was usually obtained at a concentration of 0.1γ/ml. The response to thiamine hydrochloride was not linear in concentrations of 0.01–1.0γ/ml.

The results presented indicate that under the described conditions d-calcium pantothenate and thiamine hydrochloride are nutritional requirements for most strains of *Mbm. lacticum* used in this study.

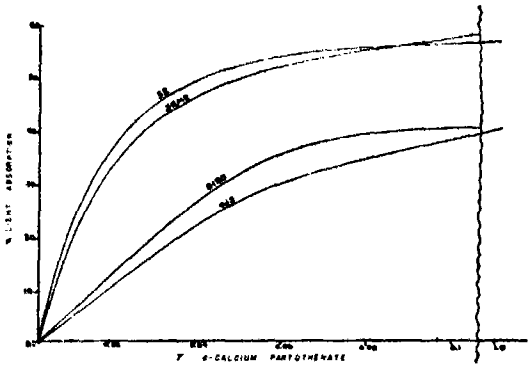

FIG. 1

Total growth in the basal medium as determined in these experiments was less than that in the natural medium, which indicates that an additional factor or factors are required for optimum growth.

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IN THE LABORATORY

A Rapid Method for Estimation of Use-Dilution Concentrations of Quaternary Ammonium Germicides

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The increased use of quaternary ammonium germicides as sanitizing agents for eating and drinking utensils, dairy and food processing equipment, etc., has accentuated the need for a satisfactory, rapid "use-dilution" test for determining the concentration of active quaternary ammonium agents in rinse waters. Dubois (*1*) has recently prepared a comprehensive review and evaluation of the methods that have been proposed for the chemical analysis of this group of compounds. While most of these give reliable and accurate results, under carefully controlled titration procedures, there still remains a demand for a simple test which is rapid and requires no elaborate apparatus. Furthermore, of particular importance to the sanitary engineer and public health officer is a test not only involving the latter requirements but also providing a reasonably accurate estimation of the bactericidally active concentration of quaternary ammonium germicide in the presence of inorganic and, in particular, organic matter.

It is generally recognized that many compounds of anionic nature, such as detergents and soaps, as well as proteinaceous substances, *i.e.* egg albumin, peptones, milk, serum, etc., are not compatible with the cationic quaternary ammonium germicides. This incompatibility is often evidenced by the appearance of a turbidity which varies in intensity with volumes and concentrations when the compounds are mixed. It was postulated, therefore, that it would be possible to arrive at a suitable volume and concentration of one of these incompatible substances, which when combined with a quaternary ammonium germicide, would give by the degree of turbidity a reasonably accurate indication of the concentration of the bactericidally active quaternary present in a solution.

For purposes of sanitation, most quaternary ammonium germicides are recommended for use in concentrations ranging from 166 ppm (1:6,000) to 250 ppm (1:4,000) (*3*). Thus, the objective of a rapid use-dilution test should be the demonstration of the presence or absence of such concentrations in the unknown solution.

In exploratory tests concentrations of 125, 166, 250, and 500 ppm of benzalkonium chloride (U.S.P. XIII) were prepared in water. To varying quantities of each of these concentrations were added varying amounts and different concentrations of several anionic detergents. The results of this study revealed, however, that the anionic substances failed to show any progressive differences in turbidity which could be correlated, within a reasonable degree of accuracy, with the concentration of quaternary ammonium germicide with which they were mixed. For this reason, further studies on anionic reagents did not appear warranted.

Encouraging results were obtained in studies using normal horse serum in combination with germicidal concentrations of quaternary ammonium compounds. As an example, when 1 drop of undiluted serum was added to 1-ml. quantities of varying concentrations of benzalkonium chloride, the following degrees of turbidity resulted:

1,000 ppm	(1:1,000)	++++	Marked turbidity
500 "	(1:2,000)	++++	" "
250 "	(1:4,000)	++	Moderate turbidity
166 "	(1:6,000)	+	Trace
125 "	(1:8,000)	––	No turbidity

With the evidence obtained in the turbidimetric analysis of benzalkonium chloride, the investigation was extended to include the several other quaternary ammonium compounds of different structural configurations. By using a constant volume of 1 drop of horse serum, as before, results comparable to those noted in the benzalkonium tests were obtained with n(acylcolaminoformylmethyl)-pyridinium chloride, p-tertiaryoctylphenoxyethoxyethyldimethylbenzylammonium chloride, cetylpyridinium chloride and 9-octadecenyldimethylethylammonium bromide. The test for turbidity in all instances was read at a 15- to 30-second time interval following the addition and shaking of the horse serum in the unknown quaternary ammonium solutions. A moderate to heavy turbidity developing within the time indicated is taken as evidence that the sanitizing solution contains at least 250 ppm (1:4,000) of quaternary ammonium germicide. The addition of 10 per cent aqueous safranine (prepared from a saturated alcoholic solution), to give a final concentration of 4 per cent in the horse serum, will facilitate the ease in reading the degrees of turbidity, and chloroform will serve as a preservative for the serum.

The specificity of the test method in the presence of substances known to completely or partially neutralize the bactericidal action of quaternary ammonium germicides was carried out in the following manner: To an equal volume of 1,000 ppm (1:1,000) benzalkonium chloride was added a neutralizing agent. In the event a precipitate resulted in this combination, the mixture was clarified by filtration through paper. One drop of horse serum reagent was added to 1 ml. of the clear solution and the presence or absence of turbidity noted. For purposes of comparison, the mixtures were also tested by the Dubois modification of the Hartley-Runnicles colorimetric procedure (*2*). The results of this study are presented in Table 1.

Examination of the data reveals several pertinent points, among which are the following: (a) The colorimetric method on the unfiltered, turbid mixtures gives values which are consistently higher than the same solutions which have been filtered. While this may not directly indicate inactivation of the quaternary ammonium germicide, it is evidence of adsorption of the compound on the inactivating agent. Since in all instances filtration of turbid mixtures is necessary in carrying out the turbidimetric method, this obviates testing adsorbed quaternary ammonium compounds. (b) Certain quaternary-inactivator combinations will react with the indicator in the colorimetric test to give color complexes ("off color") not associated with the assay. In no instance was there any evidence of a similar interfering action in the horse serum reagent test.

TABLE 1

COMPARISON OF HARTLEY-RUNNICLES (DUBOIS) COLORIMETRIC AND HORSE SERUM TURBIDIMETRIC METHODS FOR DETERMINATION OF QUATERNARY AMMONIUMS

Quaternary ammonium (1:1,000 + inactivating agents)	Colorimetric (ml. Duponol "C")	Turbidimetric (1 drop serum)
Soap 1:1,000 (unfiltered)	1.5	———
" 1:1,000 (filtered)	0.3	0
" 1:100 (unfiltered)	No reaction	———
" 1:100 (filtered)	No reaction	0
Santomerse 1:1,000 (unfiltered)	1.0	———
" 1:1,000 (filtered)	0.3	0
" 1:100 (clear)	No reaction	0
Duponol "C" 1:1,000 (unfiltered)	Off color	———
" " 1:1,000 (filtered)	0.3	0
" " 1:100 (clear)	No reaction	0
Egg albumin 1:1,000 (clear)	2.4	+++
" " 1:10 (unfiltered)	Off color	———
" " 1:10 (filtered)	2.0	++
Evaporated milk 1:100 (unfiltered)	2.3	———
" " 1:100 (filtered)	1.6	++
" " 1:10 (unfiltered)	1.8	———
" " 1:10 (filtered)	0.6	Trace
Orange concentrate-undiluted (unfiltered)	Off color	———
" " " (filtered)	Off color	Trace
Ice cream 1:10 (unfiltered)	1.5	———
" " 1:10 (filtered)	0.7	Trace
Horse serum 1:10 (unfiltered)	2.5	———
" " 1:10 (filtered)	1.5	Trace
" " 1:5 (unfiltered)	Off color	———
" " 1:5 (filtered)	3.2	0
" " 1:2 (unfiltered)	Off color	———
" " 1:2 (filtered)	Off color	0
Control		
Quaternary 1:1,000	4.2	++++
" 1:2,000	2.3	++++
" 1:2,000 (filtered)	2.0	++++
" 1:4,000	1.2	++
" 1:6,000	0.7	0

"No reaction"—4.2 ml. or more of Duponol reagent results in no change in color.

"Off Color"—dye used in test reacts with color in agent.

————solution turbid; impossible to test.

0—no quaternary demonstrable.

++ to ++++—moderate to marked turbidity.

Colorimetric and turbidimetric control tests on the several inactivating agents, in the absence of quaternary, in no instance showed evidence of a positive reaction indicative for quaternary ammonium compound. These data, therefore, were deleted from the table. Evidence will be presented elsewhere on the sensitivity of the present method for several homologous series of bacteriologically active and inactive quaternary ammonium germicides.

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A Simple Device for Macroscopic Sectioning of the Brain

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The principle involved in the macrotome to be described is not original but was seen and used by one of us (R. F. B.) in a much more elaborate and expensive apparatus. We have been unable to discover any American firm which manufactures such a macrotome and have concluded that the one observed was of European make and, therefore, no longer obtainable. For this reason we designed and built an instrument along similar lines, but much simpler and less expensive, which has proved entirely satisfactory.

Fig. 1

For the study of the brain and other large organs, such as the liver, it is often desired to have macroscopic sections of uniform and known thickness. This is accomplished readily and easily with the macrotome to be described. The instrument consists of a base and an end board of hard wood with a metal arch, properly supported, which is used as a guide for the knife. The thickness of the section is determined by the distance between the arch and the end board as measured by a millimeter scale attached to the side of the base and adjusted by means of a thumb screw (Figs. 1 and 2). For the base, a piece of hard wood 12 x 9 x ¾ inches is used; for the end board one 9 x 6½ x ¾ inches. Two countersunk screws are used to fasten the end board at right angles to the base. One piece of bar steel 30½ x ¾ x $\frac{3}{16}$ inches is bent to form the arch, the ends being welded and the joint buffed smooth. Two pieces of bar steel 6½ x ¾ x $\frac{3}{16}$ inches are used for the side guides, which prevent side sway and twisting of the arch. One piece of bar steel 12½ x ¾ x $\frac{3}{16}$ inches forms the center guide and pressure bar to regulate the thumb screw. This piece must be drilled and threaded to accommodate a ⅜ inch thumb screw having at least 2 inches of thread. A small piece of light metal should be fastened to the back of the end board for the thumb screw to work against and to prevent it from cutting into the wood. Four keepers of metal are used in which the guides move. To complete the apparatus four rubber feet are attached for support. Details of construction are shown in Fig. 2.

The blade used to cut the sections is 18 x ½ inches and is drawn taut in a hacksaw handle.

To cut the sections, the thumb screw is turned until the arch reaches the desired distance from the end board, as measured by the millimeter scale. The specimen is placed on the base so that it touches the end board in the desired plane. The knife is then placed against the arch and drawn through the specimen with one long stroke, taking care that it touches both sides of the arch throughout the entire stroke. In holding the specimen on the base and against the end board only a moderate amount of pressure should be exerted, *i.e.* sufficient to keep the specimen from moving.

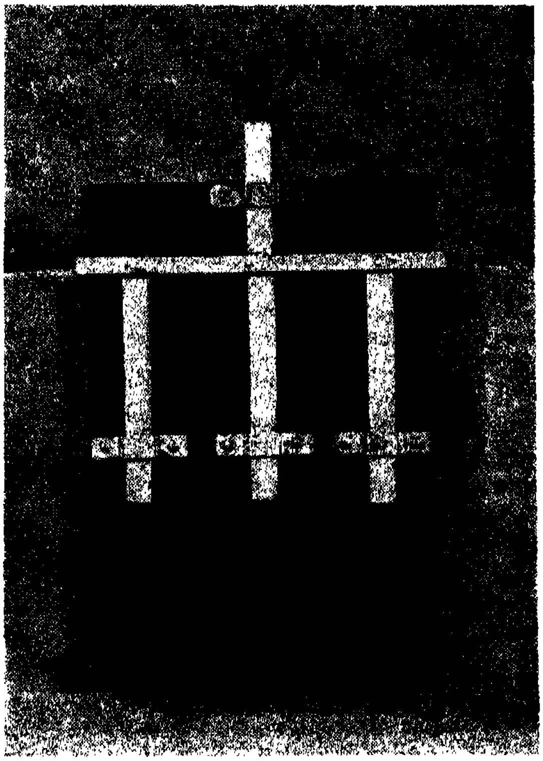

Fig. 2

Formalin-fixed specimens have been sectioned at 3 mm. with little difficulty and at 5 mm. with no difficulty. Thicker cuts have also been made. Removal of the pia mater facilitated sectioning of the brain. It was found, however, that brains embedded in agar and chilled did not section evenly because of the resistance offered to the knife by too firm a block.

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[1] We wish to express our appreciation to Otto F. Kampmeier, head of the Department of Anatomy, for affording us the facilities to do this work.

Book Reviews

High polymers.* Vol. VII: *Phenoplasts: their structure, properties, and chemical technology. T. S. Carswell. New York-London: Interscience, 1947. Pp. xii + 267. (Illustrated.) $5.50.

The purpose of this book is to describe the chemistry and physical structure of phenoplasts (resins obtained by the condensation of aldehydes with phenols) and to show the relation between their structures and their mechanical and chemical properties.

The major part of the description of the chemical structure is contained in the first 50 pages of the book. Here the works of Zinke, Hultzsch, and von Euler serve as the main basis for the development of the concept that now exists of the chemical structure of the phenoplasts. This section is followed by 18 pages of discussion devoted to an elucidation of the physical structure. The rest of the book furnishes quantitative data and other useful information on fillers for phenoplast molding powders and laminates; the effect of variables on the mechanical, electrical, and thermal properties; the chemical resistance and solubility of phenoplasts; and the manufacture, modern molding practices, and technical applications of these materials.

The literature of the last 10 years supplies the principal source material for this survey. The subject matter is presented in a very readable manner. Those who work with phenoplasts will no doubt be properly grateful to Mr. Carswell for an excellent reference book, and beginners will find the study of this book one of the best introductions to the field.

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An introduction to vertebrate anatomy. (Rev. ed.) Harold M Messer. New York: Macmillan, 1947. Pp. xx + 475. (Illustrated.) $4.75.

This book is designed for a one-semester course in vertebrate anatomy. It is the author's avowed purpose to present "a minimum amount of material," this material to be supplemented in any manner that the instructor wishes.

Approximately one-quarter of the book is devoted to (1) Introductory Remarks, (2) Taxonomy of the Chordates, in which is included the anatomy and general and specific characteristics of the protochordates, also general and specific characteristics of the vertebrates, and (3) a section on Early Vertebrate Development. The remainder of the text proper consists of a presentation and discussion of the systems of the vertebrate body, each presentation being concluded by a short summary. There is a short bibliography of suggested readings, an adequate glossary of biological and taxonomic terms, and a good index. The taxonomy has been revised. Textual material has been brought up to date and is accurate and singularly free from misprints. With few exceptions, the book is very well illustrated.

The reviewer, although having taught a one-semester course in vertebrate anatomy for a number of years, would prefer having a more comprehensive text than the one here reviewed. Taxonomy and embryology are indispensable adjuncts to the teaching of vertebrate anatomy; however, it seems that the amount of space devoted to these subjects is more than ample when compared with the rest of the book. Certain sections of the text proper have suffered because of generalizations and omissions due to brevity. Summaries might well have been omitted. It might be helpful to the student to give the actual derivations of the taxonomic terms and the derivation of some of the biological terms. Although the bibliography is short and more or less on the elementary level, additional well-known reference books in English and German might have been included—to name only one, the 2nd edition of Romer's *Vertebrate paleontology* (1945).

In spite of the above personal preferences, the text can be satisfactorily used in the course, or in a course similar to the one for which it was designed. The book should serve to "whet the appetite" of any student genuinely interested in vertebrate anatomy.

ROY P. ASH

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The work book of fundamental organic chemistry. (Rev. ed.) Ed. F. Degering and collaborators. Ypsilanti, Mich.: Univ. Lithoprinters, 1947. Pp. 256. (Illustrated.) $1.75.

This book, according to the preface, was produced in response to an urgent need to stimulate more active and less passive activity on the part of the student. It follows the plan of the author's *Outline of organic chemistry* and *Fundamental organic chemistry*. Each chapter contains (a) a review summary, (b) a genetic chart emphasizing the more important reactions, (c) nomenclature, pronunciation, and formula tables, (d) a composite review summary, (e) review questions of the fill-in type, and (f) one or more objective tests.

Every teacher of organic chemistry should examine this book, for it illustrates many excellent teaching and testing devices. The emphasis on nomenclature and pronunciation is especially commendable. This feature alone is of sufficient merit to recommend the book to anyone who wants to speak like a literate organic chemist.

Prof. Degering must find this book exceedingly valuable for use in his own classes. Teachers who use his text or outline and are in agreement with him as to course content and order of presentation will likewise find it of great usefulness. Other teachers who are masters of their field will find some parts of value but may prefer to design their own review questions and aid their students to develop their own devices for learning.

The chapter summaries are of less value than the other features of the book. In this reviewer's opinion students should prepare their own outlines and other summaries of textbook material. In spite of this criticism, however, the book is recommended as a valuable contribution to the art of teaching organic chemistry.

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The Inter-Society Committee for a National Science Foundation: Report for 1947

Dael Wolfle, *Secretary-Treasurer*

THE INTER-SOCIETY COMMITTEE FOR A National Science Foundation was formed to unite scientists in a common front on the attempt to secure a National Science Foundation in 1947. That effort failed. It failed in spite of the fact that Congress, the President, and practically all scientists agreed that a National Science Foundation was necessary. The Foundation was killed by disagreement within the Government over the *kind* of Foundation that was needed.

With nearly unanimous agreement that a National Science Foundation of some type is necessary, scientists will try again to secure the necessary legislation. Before that effort starts, it is time to review the history of the Inter-Society Committee and to ask why its efforts to influence the provisions of the legislation were unsuccessful. It is not necessary here to discuss the relative merits of the specific features of science foundation bills that have been proposed in the last few years; that has been done in a series of articles in *Science* and elsewhere.[1]

The 1946 meeting of the American Association for the Advancement of Science at Boston provided an opportunity for scientists to consider how they should attempt to secure in the 80th Congress the National Science Foundation that the 79th Congress had failed to create. It was generally admitted that the disagreements of scientists themselves during the 79th Congress had contributed somewhat to the failure to secure enactment of S. 1850. The Inter-Society Committee was conceived as a way of preventing the repetition of that error. It grew out of an informal meeting attended by W. P. Anslow, Jr., Joseph C. Boyce, Detlev W. Bronk, Robert Chambers, Karl T. Compton, James B. Conant, Watson Davis, H. Feshbach, William A. Higinbotham, Leo M. Hurvich, M. Stanley Livingston, Kirtley F. Mather, R. Newton Mayall, Fred A. Mettler, Stuart Mudd, Talcott Parsons, Philip N. Powers, Morton D. Schweitzer, Harlow Shapley, Robert M. Yerkes, and Donald Young.

These men decided that the AAAS was the organization most representative of all science and that it should take the initiative in organizing scientists for a united effort to secure a National Science Foundation. The Council of the AAAS accepted these decisions and on December 29 adopted a resolution asking the President of the AAAS to appoint two representatives and to invite the president of each affiliated society to appoint two representatives to the Inter-Society Committee for a National Science Foundation.

Acting quickly on this resolution, President Conant wrote on January 4 to the presidents of all of the organizations affiliated with the AAAS and to a few other national scientific and educational associations, inviting each to name two representatives to the new committee. He asked Kirtley F. Mather, one of the AAAS representatives, to call the first meeting of the committee.

On February 5 Dr. Mather informed the representatives that the first meeting would be held in Washington, D. C., on February 23. At that time no science foundation bills had been introduced into Congress. Several members of Congress, however, were known to be interested in such legislation and were invited to meet with the Inter-Society Committee on February 23. (Senator Elbert Thomas was the only one who accepted. He was present for an hour or so after adjournment of the meeting.)

Two days after the announcement of the committee meeting was made, two bills were introduced into the Senate. S. 525, introduced by Senator Elbert Thomas of Utah, was identical with S. 1850 as the Senate had passed that bill the year before. S. 526, introduced by Senator H. Alexander Smith of New Jersey, and others, was a new bill which was similar in many respects to the amendment to S. 1850 which Senator Smith had proposed in the 79th Congress and similar also to the earlier Magnuson Bill. Shortly afterward, four bills were introduced into the House of Representatives: H. R. 942, which was identical with S. 1850 as it had been reported to the Senate the previous year, and H. R. 1815, H. R. 1830, and H. R. 1834, all three of which were identical with S. 526. Later, H. R. 2027, also identical with S. 526, was introduced. Earlier articles in *Science* have given the content of these bills.

When the Inter-Society Committee met on February 23 it was composed of representatives, usually two each, of approximately 75 organizations which had accepted President Conant's invitation of January 4. They elected an Executive Committee of the following members: chairman, Edmund E. Day, president, Cornell University; vice-chairman, Harlow Shapley, Harvard University; secretary-treasurer, Dael Wolfle, American Psychological Association; members at large of the Executive Committee, Isaiah Bowman, president, Johns Hopkins University; Ralph W. Gerard, University of Chicago; R. G. Gustavson, chancellor, University of Nebraska;

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[1] A defense of the President's veto of S. 526 is given by Don K. Price in "The deficiencies of the National Science Foundation Bill" (*Bulletin of the Atomic Scientists*, 1947, 3, 291–294; 310). A comparison of the bills in the 80th Congress is given by Dael Wolfle in "What kind of Science Foundation shall we have?" (*Journal of Higher Education*, 1947, 18, 183–188).

Henry Allen Moe, Guggenheim Foundation; W. A. Noyes, University of Rochester; and Douglas M. Whitaker, Stanford University.

The Executive Committee was voted authority to replace any of its own members who were unable to serve.

It was generally agreed by the committee that the bills then before Congress were drafts, that amendments might be made, that the committee should not become too involved at that time in discussions of details, but that it should be interested in the main features of the bills which had been introduced. A discussion of the two Senate bills, S. 525 and S. 526, was therefore called for. John Q. Stewart of Princeton, who was present as an observer, started the discussion, reporting that he had assisted in writing S. 526 and that the basis for that bill was the amendment to S. 1850 which had been proposed by Senator Smith in the 79th Congress. The greatest difference between that bill and S. 525, he pointed out, was that S. 526 called for a large board which would select an executive committee which in turn would select the Director of the Foundation. In contrast, S. 525, like the previous year's S. 1850, authorized the President to appoint the Foundation's Administrator.

After describing differences between the two bills, Prof. Stewart suggested a questionnaire as a guide to the Executive Committee in interpreting the attitudes of committee members. After further discussion, Dr. Mather proposed an off-the-record straw vote on the preferred type of administration. The vote was taken with the following result:

Favoring a single administrator to be appointed by the President	41
Favoring the large-board type of administration suggested in S. 526	22
Favoring administration by a small board such as the Atomic Energy Commission	32
No preference among the three alternatives	18

Straw votes were also taken on two other points on which much discussion had centered: (1) The vote was unanimously in favor of including provision for fellowships and scholarships; all but 18 members were in favor of providing for undergraduate scholarships. (2) All but four were in favor of including the social sciences in the research program of the Foundation.

In closing the meeting, Chairman Day summarized the consensus of the group: Despite their differing opinions on individual features of the bills before Congress, scientists—all of them—had to get together to support the kind of National Science Foundation favored by a majority, for if they failed to agree and failed to make their support unanimous, there might be no Foundation.

After the meeting adjourned, John H. Teeter informed the officers that the House of Representatives Committee on Interstate and Foreign Commerce would hold public hearings on science foundation bills on March 6 and 7. Mr. Teeter assisted the House Committee in arranging these hearings. A few days later the Committee on Interstate and Foreign Commerce invited Chairman Day to testify on March 6.

On March 5 the Executive Committee held its first meeting. Present were Day, Shapley, Wolfle, Gerard, Gustavson, and Whitaker. Isaiah Bowman and W. A. Noyes had been unable to accept their appointments, Dr. Bowman because of the pressure of other duties, Dr. Noyes because of ill health. The Committee had not at that time, and did not later, receive a reply from Mr. Moe to his invitation to serve.

The Executive Committee considered possible alternates for Bowman and Noyes. It was agreed that Day would discuss with Bowman the selection of a person who had served actively in the group which had the year before formed the *Committee in Support of the Bush Report*. The Executive Committee agreed that a representative of that group was highly desirable. C. G. Suits, vice-president of the General Electric Company, was chosen as a replacement for W. A. Noyes and accepted appointment.

The Executive Committee considered at some length the position it should take and the kind of testimony which Chairman Day should offer on the following day. It interpreted its task as reporting the majority judgment of scientists rather than one of making its own decisions as to what should or should not be included in a science foundation bill. In line with this policy, the Committee decided that for the time being it would not support or criticize the specific points of any bill, but would limit itself to support of those features which were generally agreed upon.

On March 6, Chairman Day testified before the House of Representatives Committee on Interstate and Foreign Commerce. After a description of the Inter-Society Committee, he testified that the foundation bill, whatever its specific provisions, should include the following features:

(1) Provision for the support of fundamental research without reference to questions of immediate practical applications.

(2) Freedom for the Foundation to investigate problems in any scientific area by any appropriate method.

(3) Provision for scholarships and fellowships for the training of young scientists.

(4) Coordination of scientific research conducted by other groups in order that the Foundation should have both the responsibility and the authority to assume leadership in planning ways to meet the country's scientific needs.

In conclusion, Day asked for permission to submit later a statement summarizing the judgment of members of the Inter-Society Committee on specific provisions of the bills. Chairman Wolverton replied that his committee would very much appreciate receiving such a statement and asked that it be submitted at the earliest possible opportunity.

On March 11 the Executive Committee mailed a questionnaire to all members of the Inter-Society Committee. Questions were included on four points: preferred type of administration; patent provisions; inclusion of the social sciences; and inclusion of undergraduate scholarships. The questions were preceded by a discussion of the issues involved, a statement of the judgment of the Executive Committee on the point in question, and a summary of the views expressed by the witnesses who had testified at the House Committee hearings on March 6 and 7. Air mail return of the questionnaire was requested, since at that time we understood that early action would be taken by the House Committee.

On March 19 replies had been received from 73 per cent of the members of the entire Committee. The results were summarized and presented in a formal report which went to all members of the committees in the Senate and House of Representatives which were considering science foundation bills. Copies were also sent to the authors of those bills.

On the question of preferred type of administration, two-thirds of the members preferred a single administrator. The exact tally was: single administrator appointed by the President, 63 per cent; 48-man foundation provided in S. 526, 18 per cent; small, full-time commission, 18 per cent. These were the preferences. The members, however, in large majority considered the bill as a whole more important than the question of administration, and 86 per cent said that, if necessary to secure passage of a bill, they would be willing to accept any of the three types of administration.

On the question of inclusion of the social sciences, 49 per cent favored specific inclusion in the bill; 48 per cent favored permissive inclusion (allowing the Foundation to support work in the social sciences whenever it saw fit); 2 per cent favored excluding the social sciences.

On the parallel question of what treatment of the social sciences was acceptable, 98 per cent were willing to accept either outright or permissive inclusion; only 37 per cent were willing to accept the bill if the social sciences were definitely excluded.

On the question of undergraduate scholarships, 86 per cent favored inclusion and 14 per cent favored prohibition of undergraduate scholarships.

On the patent question, 94 per cent thought that no special stand should be taken by the Committee. The other 6 per cent believed that we should recommend adoption of the patent provisions contained in S. 525 and H. R. 942 (the S. 1850 provisions).

The major results of this questionnaire were in close agreement with two other surveys, one conducted by the Federation of American Scientists and the other made among California scientists. All three of these polls, although conducted in different ways, with different groups, and at different times, agreed closely in showing that scientists overwhelmingly wanted a science foundation, that a two-to-one majority preferred a single administrator, and that they believed that the social sciences should be included.

The agreement of these three polls, and the fact that the members of the Inter-Society Committee were the chosen representatives on science legislation of over 75 scientific organizations, persuaded the Executive Committee that its report to the Senate and House committees represented the best evidence available on what the majority of scientists in America considered wise in a National Science Foundation.

Yet little attention was paid to that report by either Congressional committee. Congressional leaders appeared to have decided what features should be included in the bill and to have little interest in any views not supporting those decisions. On March 19 I sent to Senator Smith a copy of the report described above. It indicated a two-to-one opposition to the administrative proposals of S. 526. On that same date, Senator Smith wrote me saying that any further consideration of the questioned features of the proposed legislation would be at the risk of not having it considered in the first session of the 80th Congress. The Committee on Labor and Public Welfare therefore held no public hearings. On March 20 it reported favorably S. 526, with one or two minor amendments. Chief of these was cutting the Foundation membership from 48 to 24.

The Executive Committee met again on April 28 with Day, Shapley, Wolfle, Gerard, Suits, and Whitaker present. Gustavson was absent. Homer W. Smith, who had been active in the earlier *Committee in Support of the Bush Report*, met with the Committee.

The most important topic for consideration was the question of whether the Executive Committee should endorse S. 526 as it had been reported out of the Senate committee or should press for amendments which would bring it into closer agreement with the majority wishes of the scientists represented. Decision was left in the hands of the three officers who conferred during the next two days with a number of government representatives. On May 1, Chairman Day wrote Senators Taft and Smith and Representative Wolverton, giving the Committee's endorsement of S. 526 and recommending two amendments: decreasing the size of the Foundation from 24 members to 9, and providing for Presidential appointment of the Director after consultation with the Foundation.

This date, May 1, marked a turning point in the efforts of the Executive Committee. Since February 23 it had been working under the dual mandate of trying to get a National Science Foundation and of trying to get a National Science Foundation that would include the specific features considered desirable by most scientists. Up until May 1 the Executive Committee kept both objectives in mind and sought on every occasion to secure consideration of amendments to S. 526 which would bring it into better agreement with the majority judgment of scientists. The recommendations contained in the letter of May 1 were frankly compromises. After that date the Executive Committee made no further efforts to secure amendments, but simply endorsed the idea of a Foundation and endorsed the bills passed by Congress.

The recommendation of May 1 that the President appoint the Director was adopted by the Senate. On May 13, Senator Smith replied:

> I have also conferred with the President on this matter and I am working out with Mr. Webb, Director of the Budget, a formula which takes care of this matter and which is in line with your suggestion. I hope that this formula will be approved at an early date so we can go ahead with the Bill.

In Senate debate on May 20, Senator Smith reported that this suggestion had been discussed in a conference with Mr. Webb and Dr. Bush and that later he, Senator Saltonstall, and Mr. Webb had discussed it with President Truman.

On May 14 to 20 the Senate debated S. 526. Debate was led by Senator Smith for the Republican party and Senator Kilgore for the Democratic party. Two important amendments resulted from the debate. Provision similar to that previously included in S. 525 for distribution of part of the funds on a geographical basis was adopted after long debate by a vote of 42 to 40. The compromise allowing the President to appoint the Director, which was proposed in Chairman Day's letter of May 1, was introduced as an amendment by Senators Magnuson and Fulbright. It was supported by Senators Smith and Saltonstall. All four stated that this amendment was frankly a compromise, that individually they did not all like it but that it would probably be acceptable to the President, and that it was probably the only compromise that would be generally acceptable and would make establishment of the Foundation possible. Senator Taft vigorously opposed the amendment. On a roll-call vote it carried by a single vote. S. 526, as amended, then passed by a majority of 79 to 8.

On the following day Senator Smith introduced a motion to reconsider the vote but later withdrew that motion. Senator Taft was quoted by the *New York Times* as saying that he intended to recommend to the leaders of the House that the amendment granting the President power to appoint the Director be removed when the bill came up for House of Representatives consideration.

For the next six weeks it seemed that the House of Representatives Committee on Interstate and Foreign Commerce, which then had the bill, might not report it out in time for action before Congress adjourned in July. On July 7, Representative Wolverton, chairman of the Committee, introduced H. R. 4102, a bill substantially like the original S. 526. It was referred to Mr. Wolverton's committee, which reported it out favorably on July 10. The administrative plan described in H.R. 4102 consisted of a Foundation of 24 members who would elect an executive committee of 9 members which would select the Director of the Foundation. No provision was made for geographical distribution of funds. Both of the significant amendments which had been made in the Senate were therefore missing from the House bill. This bill passed the House of Representatives by a voice vote on July 15.

S. 526, as passed by the Senate, and H.R. 4102, as passed by the House, were then sent to a joint Senate-House of Representatives conference to resolve the differences, of which the two major ones were the type of administration and the question of geographical distribution of a portion of the funds. On both issues the resolution was in favor of the House bill. Both houses passed the compromise measure and thus sent to the President a bill which differed only in minor ways from S. 526 as it had been reported out by the Senate committee on March 20.

The Executive Committee sent President Truman a long telegram urging him to sign the bill. Prof. Shapley was particularly active in this effort and arranged for telegrams to the President from a number of sources recommending his approval. Decision by the Executive Committee to urge this action was taken with some reluctance. Ever since the beginning we had been attempting to secure changes in the bill to make it agree more closely with scientists' wishes. The primary objective of the Inter-Society Committee was to secure a National Science Foundation. The bill on the President's desk was the only possibility. Urging him to sign it was, we felt, necessary to comply with the mandate of the Inter-Society Committee.

The President withheld his approval of the bill. *Science* has already published his reasons for the pocket veto (September 12, p. 237). The insistence by the Congress upon a type of administration which the President and his advisers did not consider workable killed the Science Foundation for 1947.

The Inter-Society Committee failed to accomplish its purpose of having a National Science Foundation created. If there are degrees of failure, it failed even more completely in securing a Foundation with the features which most scientists consider desirable. Why did it fail?

One reason may be that the Executive Committee never engaged in any of the behavior ordinarily called political. It obtained and it presented the majority judgment of the members of the Inter-Society Committee. It laid all its cards on the table from the very beginning by reporting not only majority judgments but also the extent of the majority and the fact that members of the Inter-Society Committee were willing to compromise. That is not a strong bargaining position, but the Executive Committee never attempted to bargain. Perhaps the honest objectivity of its reports and recommendations was politically naive and tactically bad.

A second reason may lie in an early decision both by the Inter-Society Committee as a whole and by the Executive Committee that they wanted very much to avoid the kind of situation which arose in the 79th Congress. A Senate majority and a majority of scientists had then agreed on S. 1850. Dissenting groups of scientists had agreed to support that bill. A few men prevented its passage by introducing a rival bill and withdrawing their support from S. 1850. In 1947 the picture differed. What had been a minority amendment became a majority bill. The Executive Committee felt that it might have killed that bill by starting a fight. Its real desire for peace may have inhibited stronger action in support of amendments to S. 526.

A third reason may lie in the great weight attached to the advice of a few very prominent scientists. The Congressmen most directly responsible for science legislation appeared to attach much less importance to the views of a two-thirds majority of scientists than they did to those of a few particularly prominent ones. The prestige of a few names was used to support S. 526 and to rebuff any suggestions for change in that bill.

The 80th Congress will reconvene in January. The effort to secure a National Science Foundation should be renewed then. There is now almost unanimous agreement on the necessity of a National Science Foundation. The Senate has twice and the House of Representatives once passed such a bill. The President has repeatedly endorsed it. The Steelman Committee report carries strong arguments in its favor. The great majority of scientists, individually and through their associations, have spoken in its favor. This unanimity of support should be remembered in planning for 1948. The argument is no longer whether we should have a Foundation or not. It is one of what kind of Foundation we should have. It is agreement on the specific features of a Foundation that is now necessary. If scientists are willing and able, without important dissenting individuals or groups, to work for the early enactment of the kind of bill which the majority of scientists consider best, if they are willing to work individually by presenting their case to their own Congressmen, a generally satisfactory National Science Foundation law in 1948 is a strong possibility.

The Inter-Society Committee for a National Science Foundation will meet in the Louis XVI Room of the Sherman Hotel in Chicago at 10:00 A.M. Sunday, December 28.

Obituary

Lorande Loss Woodruff

1879–1947

Lorande Loss Woodruff, Colgate professor of protozoology at Yale University and director of the Osborn Zoological Laboratory, died at his home in New Haven after a long illness on June 23, 1947, in his 68th year. With his passing the Corporation of the Marine Biological Laboratory loses a member of more than 40 years standing and the Board of Trustees one who had served faithfully for 24 years.

Woodruff was born in New York on July 14, 1879, and received his education in his native city, graduating from Columbia University with the A.B. degree in 1901 and the Ph.D. in 1905. Before completing his graduate work he was appointed assistant and later instructor in biology at Williams College, where he remained until he was called to Yale in 1907. There he served successively as instructor, assistant professor, and professor until his death. He became chairman of the Department and director of the Osborn Zoological Laboratory in 1938, but took leave of absence in November 1946 on account of ill health.

His connection with the Marine Biological Laboratory began in 1905, when he attended the summer session as investigator and instructor in the invertebrate course and was elected to membership in the Corporation. Four years later he joined the staff of the course in embryology, of which he remained a member until 1914. During the absence of Dr. Calkins in the summer of 1927 he was in charge of the course in protozoology. Elected to the Board of Trustees in 1923, he served with them until his death, and during the years 1930–32 he was a member of the Executive Committee.

Coming to Yale at a time when a radical reorganization of the instruction in biology was to be undertaken, Woodruff took part from the first in teaching general biology and in 1910 assumed full charge of the general course in Yale College. This he built up into one of the soundest and, at the same time, most popular courses in the University. Through the years thousands of students listened to his masterly lectures, later incorporated in his textbook, *The foundations of biology*, which has been very widely used and has run through 6 editions.

Woodruff's research was exclusively in the field of unicellular organisms. Beginning with his doctoral dissertation, which was done under the direction of the late Prof. Calkins and published in 1905, he made many contributions to our knowledge of the life history of ciliates, their division rate, nuclear reorganization, and the effect of environmental factors on their life cycle. He is perhaps best known for the famous pedigreed race of *Paramecium aurelia*, which was carried for 8 years with daily isolation of the products of division, thus precluding conjugation and showing that these organisms can reproduce asexually indefinitely without dying out. In the first 8 years over 5,000 generations were obtained, and afterward the culture was carried in a less rigorous manner, though sufficiently carefully to exclude conjugation except possibly between closely related individuals. The culture has now reached more than 24,000 generations without loss of vigor. In the course of this work Woodruff and Erdmann discovered that, corresponding to the rhythms in division rate, the nuclei of the paramecia undergo a reorganization process which they termed 'endomixis' and which they described as a form of nuclear reorganization without syncaryon formation. This stirred up much discussion, and more recently the process has been described by others as autogamy, involving fusion between micronuclei from the same cell.

His research naturally attracted graduate students, and throughout the years many have written their dissertations under his direction and carried his methods to new centers, just as his assistants and students in the course in general biology, many of whom have become teachers, have spread his ideas of the teaching of biology throughout the land.

Woodruff was intensely interested in the history of science. Early in his career at Yale he organized a course in the history of biology which he continued throughout his life. He was a collector of scientific books of historical significance. He published a number of essays and addresses in this field and organized two series of lectures on the history of science under the auspices of Gamma Alpha Fraternity, which were later published in book form under his editorship. A paper on "Baker on the Microscope and the Polype" led to a friendly encounter with a descendant of Trembley, the famous author of the treatise on *Hydra* published in 1744.

Woodruff was chairman of the Division of Biology and Agriculture of the National Research Council in 1928–29. He was a member of many scientific societies, including the National Academy of Sciences, the American Society of Zoologists, of which he was secretary-treasurer in 1907–09 and president in 1942, the American Physiological Society, the American Society of Naturalists (vice-president, 1923), the American Association for the Advancement of Science (Fellow), and others. He was a member of Phi Beta Kappa, Gamma Alpha, and Sigma Xi, having been president of the Yale Chapter of the last in 1915. He lectured on protozoology at four summer sessions of the Mountain Laboratory of the University of Virginia. For two terms of three years each he was an associate editor of the *Journal of Morphology*. In 1935 he received the Townsend Harris medal from the College of the City of New York, where he had been as a student before entering Columbia

For one who was closely associated with Woodruff for nearly 40 years, it is difficult to realize that this intimate relation has been forever broken. The association was one of mutual trust throughout and without serious disagreement. He was always on the side of high standards, which he applied to himself as well as to others. Indeed, this was one of his outstanding qualities, as was his intense loyalty to the institutions he served. He was quiet and reserved, but with a kindliness that meant much to those about him. With all of his reserve he could be deeply moved, and he never recovered from the shock of Mrs. Woodruff's death, which came with such cruel suddenness in March 1946.

The members of the Corporation of the Marine Biological Laboratory desire to record their sorrow over the loss of one of their body, a friend and fellow servant whom they will miss acutely and whose memory they will always cherish.

Ross G. Harrison

Yale University

[The above memorial was read at the meeting of the Corporation of the Marine Biological Laboratory, Woods Hole, August 12, 1947.]

Association Affairs

Centennial Meeting of the AAAS, 1948

On September 20, 1848, the American Association for the Advancement of Science was formally established. Next year, by vote of the Executive Committee of the Council, it will celebrate the 100th anniversary of its founding in a meeting to be held in Washington from September 13 to September 17, inclusive.

The centenary of the Association will not be simply an occasion for reviewing its hundred years of achievements; the times call for more serious purposes. The future of civilization appears to depend in large measure on science, and consequently the Association faces much heavier responsibilities to society than it has heretofore anticipated. Clearly, the centennial celebration next year may appropriately pay tribute to our predecessors, but it should also critically examine the present and make plans for an arduous future.

At a meeting a few weeks ago the Executive Committee appointed the following Centennial Policy Committee to draw up general plans for the Association's centenary next year: Harlow Shapley (chairman), E. W. Sinnott, E. U. Condon, Roger Williams, W. M. Stanley, James Gilluly, J. M. Hutzel, and F. R. Moulton. The Committee was instructed to formulate plans for (a) the Centennial Meeting, (b) the Centennial Membership Drive, and (c) the Centennial Fund Campaign. This report will be limited to the first of the three duties imposed upon the Committee.

As a general theme for the Centennial Meeting the Committee chose *One World of Science*, meaning by these words that science is the same throughout the world, irrespective of language, politics, and race, and meaning, also, that this unity in science provides rapidly expanding nuclei of men having mutual understanding, respect and cooperation—the only promising foundation for permanent peace.

In order to make effective plans for carrying out the general policies adopted by the Committee, it was decided to organise three quite distinct types of programs, one type for the mornings, another for the afternoons, and still another for evenings. It will be sufficient to characterize briefly the three kinds of programs, which, because of their nature, make it obviously inadvisable to arrange concurrent sessions for any of the affiliated or associated societies.

At the first evening session on Monday, September 13, 1948, Dr. Harlow Shapley will deliver his address as retiring president of the Association. It is hoped that the President of the United States will be present at this meeting and that he will welcome the Association to Washington and express his appreciation of the contributions scientists are making to human welfare. Other governmental officials of high rank are expected to be present on this occasion, for a justice of the Supreme Court, an ex-president of the United States, a United States senator, as well as hundreds of other governmental officials and employees in Washington, are members of the Association.

It is expected, also, that representatives of all the foreign embassies will attend this first evening session, and many other sessions as well. This expectation rests partly on the clear realization of all that there is "one world of science" in which their peoples participate, and also on the fact that the Association has members in 76 foreign countries.

It is expected that many prominent residents of Washington who are not professional scientists will also attend the first evening session, and other sessions, for they know how greatly society is indebted to science and how much the great scientific societies whose headquarters are in Washington add to the life and culture of this capital city.

Following Dr. Shapley's address there will be a reception with high-ranking governmental officials and members of the diplomatic corps, as well as presidents and past-presidents of the Association, in the receiving line. This notable occasion obviously will be in tune with the theme that there is but "one world of science," a phrase of only four words on which, when fully understood, the highest hopes for the future of mankind rest.

The morning sessions, as outlined by the Centennial Policy Committee, will consist of broad symposia on the major fields of science, participated in by the foremost authorities and intended to be major contributions to the exposition and integration of science. Since the meeting will be limited to five days, it is expected that several morning programs in different fields will be presented simultaneously. The afternoons, according to plans, will be devoted to prearranged visits to the numerous scientific laboratories, libraries, art galleries, and educational and governmental institutions with which Washington abounds.

It would be impossible for the officers of the Association to achieve the possibilities the centenary offers without the full cooperation and assistance of many scientific organizations and scientists in Washington. Invitations were sent out a few weeks ago to the chief executive officers of all the leading governmental, scientific, and cultural agencies in Washington and environs to accept membership in the Honorary Local Planning Committee and to appoint representatives of their respective organizations on the active committees as they are organized. The replies received were gratifying. Not only have the invitations been almost universally accepted, but nearly all of the acceptances have contained very cordial words of approval and expressions of pleasure in rendering the desired assistance. The general committee has met, with 27 members in attendance, and a subcommittee on planning has drawn up specifications for 12 special committees whose duties range from finance to entertainment. Preparations for the Centennial Meeting of the Association next year are well under way.

What does the extraordinary interest in the Association's centenary mean? It means that the Association and its purposes are approved. More importantly, it means the general realization, though not expressed, that there is "One World of Science."

F. R. Moulton
Administrative Secretary

NEWS *and Notes*

Robert S. Breed, professor of bacteriology, Division of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, retired November 1 after 34 years of service.

W. A. Hamor, assistant director, Mellon Institute for Industrial Research, Pittsburgh, has been appointed editor of the American Chemical Society Monographs, succeeding the late **F. W. Willard.** The Monographs, established in 1920, comprise outstanding reports on research developments in chemical science.

W. Harry Lange, Jr., University of California, Davis, has been granted a 6-month leave of absence to accept an assignment with the Navy through the auspices of the National Research Council. He will study the giant snail and cocoanut beetle, *Brontispa*, in the Marianas Islands and other Asiatic areas. Dr. Lange may also visit the Philippines and the Malay Archipelago in search of natural enemies of this beetle. In addition to devising artificial means for controlling the giant snail, arrangements have been made to collect parasites in Africa which will be forwarded to the Marianas for liberation.

John R. Buhler, associate professor of oral surgery, and secretary to the faculty, Temple University School of Dentistry, has been appointed dean, Emory University School of Dentistry, effective September 1, 1948. He will succeed **Ralph R. Byrnes,** whose request for retirement at that time has recently been granted.

L. W. Le Roy, subsurface geologist, Richmond Exploration Company, Venezuela, has been appointed associate professor, Department of Geology, Colorado School of Mines, Golden, Colorado.

Jules H. Last, recently captain, U. S. Army, who received the Ph.D. and M.D. from the Universities of Chicago and Illinois, respectively, has been appointed assistant professor in the Department of Pharmacology and Toxicology, University of Illinois.

Hyman I. Goldstein was honored on his 60th birthday, November 2, by the National Gastroenterological Association, which dedicated the 15th anniversary number of *The Review of Gastroenterology* to him in recognition of his services rendered to, and his interest in, the Association.

Percival Bailey, distinguished professor of neurology, University of Illinois School of Medicine, delivered the annual James Greenwood Lecture in Neurology at the University of Texas Medical Branch, Galveston, on "The Organization of the Cerebral Cortex." The lecture was arranged to be given in connection with the Central Neuropsychiatric Association which met in Galveston, October 17–18.

Donald Gray, associate professor of anatomy, Stanford University, has been appointed National Institute of Health Fellow and visiting associate professor of anatomy, Wayne University College of Medicine. Under a grant from the Institute he will collaborate with **Ernest Gardner** on a study of the physiology and morphology of human joints.

Visitors to U. S.

Oldrich Karel Sebek, a graduate of the Faculty of Science, Charles University, Prague, Czechoslovakia, is a member of the Seagram International Fellowship Program, observing operations and doing research work at the Louisville, Kentucky, plant of Joseph E. Seagram & Sons, Inc.

Several Australian scientists are now visiting the United States. Among them are **J. L. Pawsey,** Division of Radiophysics, Council for Scientific and Industrial Research, who arrived October 15 to visit American laboratories doing research in radiophysics, and who will remain in this country until early spring; **A. J. W. Moore,** metallurgist, Section of Tribophysics, Council for Scientific and Industrial Research; **D. Martin,** Horticulture Section of Plant Industry, Tasmania, who is studying the growth, ripening, storage, canning, and dehydration of apples; and **H. F. Holden,** research chemist, Walter and Eliza Hall Institute of Medical Research, Melbourne, who is studying physical equipment which might be used in the study of viruses.

Fe del Mundo, professor of pediatrics, University of Santo Tomas, and director of the Children's Hospital, Manila, has been appointed visiting lecturer in pediatrics at the University of Texas Medical Branch, Galveston. She will spend a month in residence at the Medical Branch in teaching the care of infants and children in the tropics.

Grants and Awards

This year's Nobel Prize in Physics has gone to **Sir Edward V. Appleton,** secretary of the Department of Scientific and Industrial Research, London, a pioneer in radar. Sir Edward was cited for his contributions to knowledge of the ionosphere—that is, electrically conductive strata in the upper atmosphere of the earth. The Prize in Chemistry has been received by **Sir Robert Robinson,** president of the Royal Society and professor of chemistry at Oxford, for his research on biologically significant substances from the vegetable kingdom, especially alkaloids.

At the 40th annual meeting of the American Institute of Chemical Engineers on November 11 in Detroit, the A. MacLaren White Award in the Student Problem Contest was presented to **William J. Terrell,** who graduated last spring from Texas A. & M. College and is now employed at the Gulf Oil Corporation, Port Arthur, Texas. Second prize was won by **Eugene Franklin Macbell,** University of British Columbia, and third prize, by **Maurice E. Brooks,** Cooper Union of New York. At the same meeting the William H. Walker Award was presented to **Manson Benedict,** director, Process Development, Hydrocarbon Research, Inc., and **Louis C. Rubin,** manager of research, M. W. Kellogg Company, in recognition of their two papers, "Extractive and Azeotropic Distillation. I: Theoretical Aspects; II: Separation of Toluene From Paraffins by Azeotropic Distillation With Methanol," published in 1945 by the Institute. The Junior Award of the Institute, given to men under 35 for contributions to chemical engineering, went to **Harry G. Drickamer,** assistant professor of chemical engineering, University of Illinois, and **Harry H. Hummel,** formerly of Pan American Refining Corporation, Texas City, and now studying at the University of Wisconsin, for their joint paper on "Application of Experimental Vapor-Liquid Equilibria to an Analysis of the Operation of a Commercial Unit for the Purification of Toluene From Petroleum," also published in the *Transactions* of the Institute.

Merck & Company, Inc., received the 8th biennial Award for Chemical Engineering Achievement, sponsored since 1933 by the McGraw-Hill magazine, *Chemical Engineering*, at a dinner, December 3, at the Waldorf-Astoria Hotel, New York, as a feature event in the week of the National Exposition of Chemical Industries. This award, outstanding in recognition of group effort, was given to Merck & Company for pioneering the large-scale production of streptomycin.

The President's Certificate of Merit has been presented to five scientists for their outstanding contributions to the country's war effort during World War II as members of the Navy's Operations Research Group. John L. Sullivan, Secretary of the Navy, presented the citations on October 30 to **Maurice E. Bell,** physicist, Walhonding, Ohio; **William J. Horvath,** Operations Evaluation Group, Office of the Chief of Naval Operations, and currently guest at the Electronics Research Laboratory, Massachusetts Institute of Technology; **George E. Kimball,** professor of chemistry, Columbia University; **John R. Pellam,** Department of Physics, Massachusetts Institute of Technology; and **Gerard R. Pomerat,** assistant director, Division of Natural Sciences, Rockefeller Foundation.

William C. Rose, professor of biochemistry, University of Illinois, received the 13th annual Grocery Manufacturers Association of America's scientific award at a luncheon meeting, October 14, during the Association's 39th annual convention at the Waldorf-Astoria Hotel. Prof. Rose was cited for his "numerous fundamental contributions to the science of nutrition, more particularly his studies of essential amino acids; the discovery, isolation, and chemical identification of threonine; and his leadership in nutritional biochemistry."

Boris Alexander Bakhmeteff, School of Engineering, Columbia University, and **William Allan,** dean, School of Technology, College of the City of New York, will receive the Norman Medal, given annually by the American Society of Civil Engineers for the best technical article published in the Society's *Transactions*. The Medal, established in 1872 by George H. Norman, will be presented at the Society's annual meeting in New York, January 21. The winning article, entitled "The Mechanism of Energy Loss in Fluid Friction," appeared in Volume III of the 1946 *Transactions*.

Boyd H. Bode, professor emeritus of education, Ohio State University, was presented the William H. Kilpatrick Award on November 10 at Teachers College, Columbia University. The award is given by Teachers College in recognition of outstanding contributions in the field of the philosophy of education. Dr. Bode had been a member of the faculty of the College of Education, Ohio State, for 23 years prior to his retirement three years ago.

James Fitton Couch, research chemist, Eastern Regional Research Laboratory, U. S. Department of Agriculture, Wyndmoor, Pennsylvania, was one of five employees of the Department granted the "Distinguished Service Award" by Secretary Anderson on November 12. Dr. Couch received the award in recognition of his chemical research on farm products which led to the discovery that rutin, a constituent of tobacco, buckwheat, and other plants, is effective in reducing capillary fragility and permeability of the blood capillaries. He has been associated with the Department of Agriculture since 1917 and since 1940 has been in charge of the Tobacco Section at the Eastern Regional Research Laboratory.

Ida A. Bengtson, who recently retired as senior bacteriologist in the Division of Infectious Diseases, National Institute of Health, a position which she had held for a number of years, was awarded the medal of the United States of America Typhus Commission on November 3. Dr. Bengtson was cited for her outstanding contribution to the prevention and control of typhus fever during World War II. Surg. Gen. Thomas A. Parran presented the medal, and the citation was read by R. E. Dyer, director of the Institute.

W. Harley Barber, emeritus professor of physics, Ripon College, Ripon, Wisconsin, has been chosen to receive the Oersted Medal for 1947. This medal is awarded annually by the American Association of Physics Teachers in recognition of notable contributions to the teaching of physics. The formal award and presentation of the medal will take place during the annual meeting of the Association on Tuesday afternoon, December 30, 1947, in the Kent Theater, University of Chicago.

Howard N. Eavenson, president, Bituminous Coal Research, Inc., Pittsburgh, received the Percy Nicholls award, which is conferred "for notable scientific or industrial achievement in the field of solid fuels," October 20, at the banquet of the 10th national fuels conference of the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers, Cincinnati, Ohio.

Eugene Gifford Grace, chairman of the Board, Bethlehem Steel Corporation, will be awarded the Charles F. Rand Gold Medal for "distinguished achievement in mining administration," at the annual meeting of the American Institute of Mining and Metallurgical Engineers to be held in New York in February, according to an announcement made by Clyde Williams, president of the Institute, at a dinner of the Metals Divisions in Chicago, October 21.

At the last annual meeting of the ACFAS (French-Canadian Association for the Advancement of Science) the Leo-Pariseau medal was awarded to **Jacques Rousseau,** director of the Montreal Botanical Garden. This medal is granted once a year to one scientist of French-Canada for the whole of his scientific publications.

Ludwik Anigstein, professor of preventive medicine, University of Texas Medical Branch, Galveston, has recently received a grant of $2,500 from the Lederle Laboratories for the support of special studies on rickettsial diseases.

Milton G. Levine and **Robert E. Hoyt,** of the Institute of Experimental Medicine, College of Medical Evangelists, Los Angeles, have been granted $500 by the Committee on Research of the American Medical Association to continue their studies on commercial Rh antiserums.

Lewis F. Hatch, University of Texas, has recently received a $3,100 grant-in-aid from the Research Corporation of New York, a continuation of a grant received last year for basic research on the influence of geometrical isomers on the chemical activity of allylic chlorides. **Stuart Nesbitt** and **Harold Alexander** will work on the syntheses of new allylic chlorides and study their reactions. It is expected that further insight into the manner by which the arrangement of atoms influences certain chemical reactions will be obtained.

Fellowships

Five Lalor Foundation fellowships were awarded at the Woods Hole Marine Biological Laboratory in the summer of 1947. The holders of these fellowships and the subjects of investigations were as follows: **Jean Brachet** (senior fellow), University of Pennsylvania and University of Brussels, "Quantitative studies on nucleic acid synthesis in sea urchin eggs and cytochemical studies on nucleic acid distribution in developing eggs"; **Irving M. Klotz**, Northwestern University, "Study of the structural and environmental factors which influence the binding of small molecules by proteins"; **Benjamin Libet**, University of Chicago, "Localization and properties of adenosinetriphosphatase in the giant nerve fiber of the squid"; **Arnold Lazarow**, Western Reserve University, "Studies on the induction and nature of diabetes in the toad fish"; and **Claude A. Villee, Jr.**, Harvard Medical School, "Extraction and study of nucleoproteins and nucleic acids of invertebrate tissues." Similar fellowships will be available in 1948 (see *Science*, November 7, p. 442).

The University of Illinois Graduate College has announced the availability of four research fellowships to be awarded for one year in the fields of medicine, dentistry, and pharmacy at the stipend of $1,800 per year. Candidates must have completed a training of not less than 8 years beyond high school graduation, and must indicate the field of research in which they are interested and submit transcripts of their scholastic credits, together with the names of three former science teachers as references. Appointments will be announced January 1, 1948, or shortly thereafter. The fellowship year begins July 1, 1948, and in some cases, September 1, 1948. Formal application blanks may be secured from the Secretary of the Committee on Graduate Work in Medicine, Dentistry, and Pharmacy, 1853 W. Polk Street, Chicago 12, Illinois.

Colleges and Universities

A Department of Biochemistry and Nutrition was established this fall in the College of Liberal Arts and Sciences, University of Southern California. The new Department is headed by **H. J. Deuel, Jr.** Staff members are **John W. Mehl**, professor; **Richard J. Winzler**, associate professor; **Margaret G. Morehouse**, **Bradley T. Scheer**, and **Walter Marx**, assistant professors; and **Donald T. Visser**, instructor. The staff is jointly responsible for biochemistry in the University's School of Medicine.

Expansion of Oklahoma Baptist University's Geology Department, with addition of three junior-level courses during the school year 1948–49, has been announced. Courses in hydrology, introductory invertebrate paleontology, and sedimentation are to be added to the courses in physical geology, historical geology, mineralogy, and structural geology now being taught. According to President John W. Raley, completion of departmental quarters in one wing of the new science building and large additions to the fossil and mineral collections have made the expansion possible.

Industrial Laboratories

The 94 years of history behind the Bausch & Lomb Optical Company at Rochester, New York, are interesting ones. On November 3, 1853, the business that is now the world's leading producer of scientific optical instruments was founded on $60 loaned to John J. Bausch by his friend and associate, Capt. Henry Lomb. Eight years later, the two young men installed the first power lens-grinding machine in this country. During the Civil War, Lomb mailed his Army pay to his partner to keep the struggling company on its feet. In 1868 the firm began to grow and moved to larger quarters at River and Water Streets, Rochester; it moved again 6 years later to the company's present site, then with a staff of 96 men and women. The firm was now under the direction of Edward Bausch, oldest son of the founder. During the next few years, photographic lenses, bifocal lenses, binocular microscopes, and iris diaphragm shutters were designed, and during the Spanish-American War, the firm produced the Navy's first gunfire control instruments used by Dewey at Manila. Several years later, William Bausch, brother of Edward, became interested in the making of optical glass, and in 1915 turned out the first pure melt produced in America, making Bausch & Lomb the sole source of supply in this country during World War I. During the recent war, Bausch & Lomb's bubble sextants, rangefinders, periscopes, radar optics, mobile optical units, aerial mapping equipment, and dive-bomber sights were used extensively.

F. M. Hildebrandt has been appointed director of laboratories, U. S. Industrial Chemicals, Inc., and in this capacity will have general supervision of all research activities of the Company in the Baltimore area, including fermentation research, entomological research, and application research. Dr. Hildebrandt has been associated with USI since 1924.

Harold Blumberg, formerly with Winthrop-Sterling Research Institute, has become associated with Endo Products Inc. as head of the pharmacology laboratory.

The Sun Oil Company will soon consolidate its wide-spread scientific activities into a proposed Science Center at Newtown Square, Pennsylvania, at which most of the research and experimental work now being done at the Company's Marcus Hook Refinery and at its laboratories at Norwood, Pennsylvania, will eventually be carried on. When completed, the proposed Science Center will be equipped with the most modern standard facilities for petrochemical and physical research work. This reorganization of the Company's scientific activities will not affect the geophysical laboratories under the Production Department in Dallas and Beaumont, Texas, or the Automotive Laboratory and certain technical service groups at Marcus Hook and Toledo Refineries. A Physical Laboratory is already under construction at Newtown Square. This new, independent Research Department will be directed by **John R. Bates**, formerly assistant to the vice-president in charge of manufacturing. **J. Bennett Hill**, manager, Development Division, Manufacturing Department, **John M. Pearson**, director, Physical Research and Development, Production Department, and **Stewart S. Kurtz, Jr.**, manager, Experimental Division, Manufacturing Department, have been appointed assistant directors.

Meetings

The American Society of Agricultural Engineers will hold its annual winter meeting at the Stevens Hotel, Chicago, December 15–17. The meeting will feature programs of the Society's four technical divisions: Power and Machinery, Rural Electric, Farm Structures, and Soil and Water. The Rural Electric Division will consider farm wiring, use of electrical equipment to increase productive efficiency, and uses of radiation in agriculture. The Farm Structures Division will emphasize grain storage and livestock feeding with particular emphasis on the influence of design on sanitation, labor efficiency, and other economy factors. On the Power and Machinery program, flexible power transmission, power take-off drives, self-propelled field machines, and new farm machines will be discussed. The Soil and Water program will consider new developments and problems in upstream flood control, drainage, hydrology, and terracing.

The Society was organized in 1907 at the University of Wisconsin "to promote the science and art of engineering in agriculture; to encourage original research; to foster agricultural engineering education; to advance the standards of agricultural engineers among themselves and with allied technologists; to encourage the professional improvement of its members; and to broaden the usefulness of agricultural engineering." The Society now has more than 2,000 members, most of whom are agricultural engineers employed in public service, research, teaching, and agricultural extension work in state, federal, and private agencies.

The December midyear meeting of the American Pharmaceutical Manufacturers' Association will be held at the Waldorf-Astoria Hotel, New York, December 15–17. On Tuesday, the 9th annual scientific award will be presented to the American Medical Association in recognition of its fundamental contributions to public health in the field of medical research. A few of the speakers to be heard are the following: Monday morning, H. R. Horner, president, Canadian Pharmaceutical Manufacturers' Association; Fred J. Stock, president, Drug, Chemical and Allied Trades Section, New York Board of Trade, and vice-president, Charles Pfizer & Company, Inc.; E. Fullerton Cook, chairman, Committee on the *U. S. Pharmacopoeia*; and Justin Powers, chairman, Committee on the National Formulary; Monday afternoon, Morris Fishbein, editor, *Journal of the American Medical Association*; and R. L. Sensenich, president-elect, American Medical Association; Tuesday morning, Austin Smith, secretary, Council on Pharmacy and Chemistry, American Medical Association; Banquet, Tuesday evening, Edward L. Bortz, president, American Medical Association; Wednesday afternoon, J. Mark Hiebert, executive vice-president, Sterling Drug Company; William Douglas McAdams, president, Wm. Douglas McAdams Agency, New York; and Kenneth F. Valentine, president, Pitman-Moore Company, Indianapolis. Additional speakers at all sessions are to be announced.

The National Academy of Peiping recently celebrated its 19th anniversary in Peiping. S. H. Li, the associate director, presided over the ceremony, and P. C. Hsu, director of the Institute of History, and C. T. Yen, director of the Physics Institute, lectured on the occasion.

The 428th meeting of the American Mathematical Society was held at Hunter College, New York City, Saturday, October 25, with an attendance of over 200, including 185 members of the Society. C. B. Allendoerfer, Haverford College, addressed the group on "Global Theorems in Riemannian Geometry." Forty-five research papers were presented, 14 in person, and 31 by title.

Third Conference on Iroquois Research

Anthropologists of Canada and the northeastern states met for the third year at Red House, New York, October 24–26, 1947, to report and discuss researches undertaken since the previous conference. The group is again grateful to the Hon. Charles E. Congdon, chairman, Allegany State Park Commission, for making available the Administration Building on Red House Lake, and to M. H. Deardorff, of Warren, Pennsylvania, who shared with Mr. Congdon details of planning the conference. Central location in the wilderness away from cities and nearness to Seneca Indians make Red House the ideal meeting place for such a conference.

Substantial accomplishment in Iroquoian studies was manifest in reports and discussion at the several sessions. Hilton M. Hill, himself an Iroquois and retired clerk of the Six Nations Agency, Brantford, offered a provocative paper on Acculturation in Mohawk Language, which he had prepared with Martha Huot. Mrs. Huot mentioned her studies of character structure among Iroquois women.

The second day was devoted principally to archaeology. In discussing the approaches to the study of the historic archaeology of Huronia, T. F. McIlwraith, assisted by Margaret M. Thomson, related the program and summarized important results achieved in collaboration between the Royal Ontario Museum of Archaeology and the Jesuit Order.

The afternoon session preserved the high level of the morning. James B. Griffin conducted an inquiry into old theories and new light on the origin and differentiation of Iroquoian culture as revealed by archaeology, to which Richard S. MacNeish made the principal contribution by describing a study during 1947 of seriation in pottery taken from historic, protohistoric, and prehistoric Iroquois town sites. Reports on parallel field work in historic sites of Munsi and Lenape Delaware subtribes came from W. A. Ritchie and John Witthoft.

To remind the group of living Iroquois culture, Albert Jones, of the Coldspring Longhouse, brought about 20 members of the Seneca community, including Chauncey Johnny John, to perform social dances in honor of F. G. Speck, who prefaced the numbers with significant program notes.

At an executive session on the future of the Conference, held Sunday morning with W. N. Fenton presiding, sentiment was unanimous for continuing the yearly conferences, for preserving the record, and for meeting at the same place another year. It was decided to leave the formulation of an over-all plan for research in the area to a committee appointed by the chairman to report at the 1948 session.

Those present included: Guthe, New York State Museum; Leechman, National Museum of Canada; McIlwraith and M. Thomson, Toronto; Speck, Carpenter, Stern, and Anthony Wallace, Pennsylvania; de Laguna, Bryn Mawr; Dodge, Peabody Museum, Salem; Ritchie, Knoll, and Chase, Rochester; M. Huot, Columbia; Noon, Wilson College, Chambersburg, Pennsylvania; MacNeish, Chicago; Griffin, Jones, Spaulding, Coe, Howard, and Witthoft, Michigan; Hassrick, Congress of American Indians, Washington; and Fenton, Smithsonian Institution. (WILLIAM N. FENTON, *Smithsonian Institution, Washington, D. C.*)

Elections

The American Institute of Chemical Engineers, at its 40th annual meeting held November 9–12 in Detroit, elected Albert B. Newman, professor of chemical engineering, and formerly dean of engineering, City College of New York, president, F. J. Curtis, vice-president, Monsanto Chemical Company, vice-president; Stephen L. Tyler, Garden City, Long Island, executive secretary; and C. R. DeLong, consulting chemical engineer of New York City, treasurer. New directors include M. C. Molstad, head, Department of Chemical Engineering, University of Pennsylvania; John J. Healy, Jr., Merrimac Division, Monsanto Chemical Company, Everett, Massachusetts; William T. Nichols, technical assistant to the executive vice-president, Westvaco Chlorine Products Corporation, New York; and William I. Burt, vice-president, B. F. Goodrich Chemical Company, Cleveland, Ohio.

The Organic Division, American Chemical Society, has recently elected Paul D. Bartlett, professor of chemistry, Harvard University, as chairman to succeed Arthur C. Cope. Ralph W. Bost, University of North Carolina, was reelected secretary; and Ralph L. Shriner, Iowa State College, William G. Young, University of California, and Dr. Cope were named to the Executive Committee.

The International Association of Milk and Food Sanitarians, Inc., is the new name adopted by the erstwhile International Association of Milk Sanitarians, Inc., founded in 1911. The newly elected officers are as follows: president, W. D. Tiedeman; first vice-president, A. W. Fuchs; second vice-president, M. R. Fisher; third vice-president, K. G. Weckel; secretary-treasurer, J. H. Shrader.

The objectives under the enlarged scope comprise milk and general dairy products sanitation and quality, as heretofore, and, in addition, general food sanitation in its production, processing, and distribution, and in restaurant operation from the standpoint of cleanliness, safety, and quality of food and equipment; in short, in food sanitation—its healthfulness, its organoleptic quality, its attractiveness, its cleanliness, and its public health safety.

NRC News

National Research Fellowships in the Natural Sciences are available for the year 1948–49, according to an announcement from the Fellowship Office. This program, financed by grants from the Rockefeller Foundation and administered by the National Research Council for the past 28 years, is designed to permit young men and women with research ability to spend additional time in uninterrupted study. The program includes the physical and mathematical sciences, geology and geography, biological and agricultural sciences, anthropology, and psychology. Candidates must have completed the requirements for the Ph.D. Stipends are at the rate of $2,500 per year, plus travel to the place of study, but larger stipends may be granted to Fellows with dependents. Appointments are for one year, but reappointment for an additional year may be made in some cases. Applications for study abroad have been granted in cases where the additional advantages make it desirable. Further information may be obtained from the National Research Council Fellowship Office, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Deaths

W. P. Bradley, 85, research chemist, died September 14 at his summer home in Southampton, Long Island, after an illness of several weeks. Dr. Bradley was professor of chemistry at Wesleyan University, Middletown, Connecticut, from 1893 to 1914.

Max Huhner, 74, urologist who devised the Huhner Test for sterility, and chief of the Clinic, Genito-Urinary Department, Mount Sinai Hospital Dispensary, died October 4 of a heart ailment at his home in New York City.

K. H. Bouman, 73, formerly professor, Amsterdam University, and a well-known Dutch neurologist and psychiatrist, died November 8.

Sidney Isaac Schwab, 75, professor emeritus of clinical neurology, Washington University, and at one time president of the American Neurological Association, died at Phillips House, Boston, November 12, after a brief illness.

Robert F. Chambers, 60, chairman, Department of Chemistry, since 1929, and Newport Rogers professor of chemistry, Brown University, died November 17 in the Jane Brown Hospital, Providence, Rhode Island.

Edwin Diller Starbuck, 81, formerly professor of psychology, University of Southern California, and director, Institute of Character Research, died November 18 at Rio Del Marz, California.

Carlton H. Maryott, 66, professor of biochemistry at the University of Georgia School of Medicine since 1914, died November 19 in Augusta, Georgia.

Curtis Field Burnam, 70, radiologist and a member of the surgical faculty, Johns Hopkins University, died November 29 after an illness of several months.

International congresses on experimental cytology were organized, prior to the recent war, by the International Society for Experimental Cytology. At the International Cytological Congress, held in Stockholm last July under the auspices of a truncated committee of the International Society, the old society was dissolved, and a new one, the Society for Cell Biology, was founded. The new Society, a member of the International Union of Biological Sciences, will be responsible for future international cytological congresses.

At Stockholm the following officers and committee were elected: president: J. Runnström (Sweden); vice-presidents: E. Fauré-Fremiet (France), E. Newton Harvey (U.S.A.), and G. Levi (Italy); secretary-treasurer: J. F. Danielli (Great Britain); Committee: T. Caspersson (Sweden), Honor B. Fell (Great Britain), A. Frey-Wyssling (Switzerland), G. C. Heringa (Holland), H. Okkels (Denmark), and Paul Weiss (U.S.A.). Many of these officers and committee members held office in the old International Society for Experimental Cytology, of which Prof. Okkels was secretary.

Election to membership in the Society for Cell Biology will normally be based on original contributions to knowledge in experimental cytology, experimental histology, and related fields. One hundred

Foundation Members, chosen mainly from those present at the Stockholm Congress, but including a few of those who who had given distinguished assistance to the old Society, were invited to participate in the formation of the new Society. Applications for membership in the Society will be welcomed. They may be addressed to Dr. J. F. Danielli, Royal Cancer Hospital, London S.W.3, England, or to any officer or committee member of the Society. Applications should normally be accompanied by a list of references to original contributions to knowledge.

The American Museum of Natural History is sending a major expedition into Central Africa in order to explore and record photographically the only remaining "unspoiled" native region of Africa. The expedition will be led by **James L. Clark,** chairman, Department of Preparation and Installation at the Museum, who is a veteran of 25 major Museum expeditions, four of which were other African safaris. Dr. Clark has already left for Africa to complete preparations prior to the arrival of the remainder of the group, which will include **Neal A. Weber,** associate professor of zoology, Swarthmore College; **Brayton Wilbur,** president, San Francisco Chamber of Commerce, who is sponsoring the expedition; **Capt. Vivian Ward** of *Nairobi*; **Murl Deusing,** curator of Education, Public Museum, Milwaukee, Wisconsin; and 35 or more natives who will be specially trained for the work. The expedition, which will penetrate the remote southwestern Sudan and the adjoining area of southeastern French Equatorial Africa, will also study the almost extinct white Rhino, which, next to the elephant, is the largest of all land mammals and has rarely been photographed. The field research on insect life, to be under the direction of Dr. Weber, will perhaps be the major contribution of the expedition. Dr. Clark also expects that many new species of snakes, lizards, fish, and small mammals and birds will be uncovered.

Increased appropriations for the research program and activities of the Illinois State Geological Survey, a division of the State Department of Registration and Education and one of three scientific surveys that come under the purview of the State Board of Natural Resources and Conservation, have recently been approved by the General Assembly of Illinois and Gov. Dwight H. Green. The current biennial budget for geological and geochemical research amounts to $1,106,590, an increase of about $160,000 over that of the preceding biennium. In addition, the Legislature made a total appropriation of $127,550 for topographic mapping and $1,764,623 for additions to the Natural Resources Building that jointly houses the Geological Survey and the Natural History Survey.

According to **M. M. Leighton,** chief, the Survey has for the past 16 years maintained a thoroughgoing research program on the geology and mineral resources of Illinois. The chief purposes have been to meet more adequately the needs of the State's manufacturing industries, mineral industries, and construction industry; to solve groundwater supply problems; and to aid transportation development, the educational system, the citizens, and the administrative departments of the State. The scope of the Survey's program extends from studies of the geology and mineral deposits in the field through laboratory studies of mineral utilization to the economics of the flow of minerals within their natural market areas. Laboratory research includes projects of both a fundamental and an applied nature and some experimental work on pilot plant scale.

The topographic mapping of the State is carried on by the U. S. Geological Survey in cooperation with the State Geological Survey, on a matching dollar-for-dollar basis.

In addition to these activities and its widespread service to the industries of the State, the Survey maintains an Educational Extension Division which provides teaching material to the public schools on the geology and mineral resources of Illinois and popular illustrated lectures to organizations.

Detailed plans have been completed and contract awards made for two new wings to the present Natural Resources Building which will double the space available to both the Geological and Natural History Surveys.

The AF School of Aviation Medicine, Randolph Field, Texas, is establishing an aeromedical historical museum as a public service. Although aviation medicine is a comparatively new specialty, having been established in 1917, the methods and equipment it has employed both in the laboratory and in the aircraft have shown remarkable progress. Although it is feared that many of the articles of early equipment and items of historical interest may already have been destroyed or lost, it is hoped that those still remaining can be preserved. Anyone having suitable material which he would be willing to loan or donate to this museum is requested to communicate with the Commandant, School of Aviation Medicine, Randolph Field, Texas. All material loaned or donated will be credited to the donors. Early manuscripts and documents, experimental laboratory devices, aircraft oxygen equipment, parachutes, flying clothing, and all other similar items are desired.

A new monthly engineering and scientific journal world wide in scope will appear in January under the co-sponsorship of the American Society of Mechanical Engineers, the Engineering Foundation, Illinois Institute of Technology, and other organizations. Each issue of the new journal, to be called *Applied Mechanics Reviews*, will contain about 200 signed reviews, including bibliographies, of current literature in the field. **L. H. Donnell,** research professor of mechanics at Illinois Tech, has been appointed editor-in-chief, and **S. P. Timoshenko,** professor emeritus of Stanford University, a widely recognized authority on applied mechanics studies, will be editorial adviser. Offices of the publication will be located at the Engineering Societies Building, 29 West 39th Street, New York City.

The Photographic Society of America again this year held a Technical Exhibit as part of the Exhibition of Photography which was hung in the Oklahoma City Art Center in connection with its annual convention. Because of the general interest of this third exhibit two Traveling Print Shows of about 35 prints each have been selected as representative of the newer uses of photography in science and industry. These shows will be available to PSA groups, camera clubs, technical societies, engineering societies, and other scientific organizations for public hangings from December of this year through November 1948. Requests stating where the prints would be hung, the available hanging facilities, and any preference for dates should be made to Earl R. Clark, 184 Malden Street, Rochester 13, New York.

The land life of the Palau Islands in the western Pacific will be studied by an expedition headed by **Henry S. Dybas,** assistant curator of Insects, Chicago Natural History Museum. The expedition, which left October 15, is a cooperative project of the Chicago Museum and the Pacific Science Board. The Palau Islands are a part of the large Micronesian region which was formerly under Japanese control, and which the Museum has already helped to survey through a recent expedition conducted by **Alexander Spoehr,** curator of Oceanic Ethnology.

The Commission on Influenza, Army Epidemiological Board, Office of the Surgeon General, U. S. Army, recognizing the potential importance in the epidemiology of influenza of antigenic differences among strains of influenza virus, has for several years maintained under its auspices a Center for the study of strains of influenza virus under the supervision of Thomas P. Magill at the Cornell University Medical College, 1300 York Avenue, New York City.

Because the problem is one of importance in the recurrence of epidemics and in the preparation of vaccines, the objectives of the Influenza Virus Strain Study Center include a search for strains of broad immunizing potency and also for strains which differ sharply from the ones currently included in influenza virus vaccines. In addition to those purposes the Center serves as a store for potent antiserums to be distributed, in limited quantities for diagnostic purposes, to U. S. Army laboratories and Influenza Commission field units; it serves also as a store for the preservation of strains of virus.

Whether a large number of stable strains of influenza virus exist, or whether the influenza virus is a relatively unstable agent whose antigenic characteristics may readily change, has not been established; however, the rather sudden manner of appearance of strains which differ sharply in antigenic characteristics from standard strains suggests that the latter alternative may be the correct one. Regardless of which alternative is correct, the fact that such strains do appear suddenly makes it imperative that a vaccination program include a careful watch for the appearance of significant variants. Obviously, the more widespread the watch, the greater the chances of success.

The Commission on Influenza, therefore, is endeavoring to broaden the watch for significant variants by increasing the interest in the accurate laboratory diagnosis of influenza. For that reason, the Strain Study Center offers a diagnostic service by which laboratories not equipped for the work may obtain rapid identification and serological classification of strains which they have isolated. It is requested that even those laboratories which are prepared to identify the broad groups of the strains of the viruses of influenza A and B submit such strains to the Center for further study as soon as possible after isolation.

The first self-sustained chain-reacting pile was achieved five years ago this week. On Tuesday the University of Chicago honored several of the scientists who had witnessed the experiment under the direction of Enrico Fermi which took place December 2, 1942, on the University's Stagg Field.

The ceremonies were opened with a luncheon held by the Citizen's Board of the University, Henry F. Tenney, chairman of the Board, presiding. Among the speakers were Sumner Pike, vice-chairman of the AEC; Enrico Fermi; Charles H. Swift, of the University's Institute of Nuclear Studies, designer of the pile; Walter H. Zinn, director of the Argonne National Laboratory of the AEC; Farrington Daniels, of the University of Wisconsin, chairman of the Board of Governors, Argonne National Laboratory; and Robert M. Hutchins, chancellor of the University.

Later in the afternoon the group witnessed the dedication of a bronze plaque marking the site of the experiment on Stagg Field. The ceremonies included the unveiling of the plaque by Dr. Daniels and remarks by William W. Waymack, of the AEC, and Drs. Fermi, Zinn, and Hutchins.

The National Bureau of Standards has compiled a *Directory of Commercial and College Laboratories*, now available from the Government Printing Office as NBS Miscellaneous Publication M187. The *Directory* lists all testing and research laboratories, together with an indication of the type of commodities tested. The Bureau makes tests and carries out investigations for other government organizations, but does not make tests for private individuals if other laboratories can do the work with the required accuracy. Since inquiries regarding such service are often received, this classified list was assembled to inform interested persons of the location of other testing facilities and to aid purchasers not equipped to make their own acceptance tests. The geographical and alphabetical listing includes 220 commercial laboratories with 80 branches or offices and 189 college laboratories used for research and testing. The *Directory* is available only from the Superintendent of Documents, Washington 25, D. C., at $.30 per copy.

A fossil skull of the dinosaur, *Torosaurus latus* Marsh, has recently been placed on exhibit in the Hall of Earth History, Academy of Natural Sciences of Philadelphia. A restoration model of the animal is being shown with the skull, which was studied and described by Edwin H. Colbert, associate curator of Geology and Paleontology in the Academy. The skull was collected near Camp Crook, South Dakota, in 1944 by Ralph Pemberton and E. Curzon Poultney, members of the Academy.

Make Plans for—

Psychoanalytic Association, December 15–17, New York City.

Paleontological Society, December 28–31, Ottawa, Canada.

American Anthropological Association, December 28–31, University of New Mexico, Albuquerque.

American Astronomical Society, December 28–31, Ohio State University, Columbus.

Association of American Geographers, December 29–31, Charlottesville, Virginia.

Archaeological Institute of America, December 29–31, New Haven, Connecticut.

Geological Society of America, December 29–31, Chateau Laurier, Ottawa, Canada.

American Association for the Advancement of Science, 114th Meeting, December 26–31, Chicago, Illinois.

TECHNICAL PAPERS

The Disappearance of Salt From Glass Ice During Low-Temperature Dehydration, and Its Implication in Electron Microscopy

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There are empirical observations in the literature that cells can be dried without the movement of salt only if they are quickly frozen to produce a glass ice, and then if the subsequent dehydration is accomplished at temperatures below about −55°C. (see the review of G. H. Scott. *Biol. Sympos.*, 1943, 10, 277). Ordinary lyophilizing temperatures greatly exceed this and cannot be expected to immobilize inorganic ions. These findings obviously have a very important bearing on the preparation of biological materials for the electron microscope. It is for this reason that we have had in our laboratory a cryostat which is capable of dehydration at the temperature of a dry ice and alcohol mixture (−72°C.). This instrument has been in operation for more than a year, and we have prepared a considerable variety of biologically interesting specimens with it after first freezing them in liquid air. They have finally been examined with the electron microscope after such fragmentation as has been necessary.

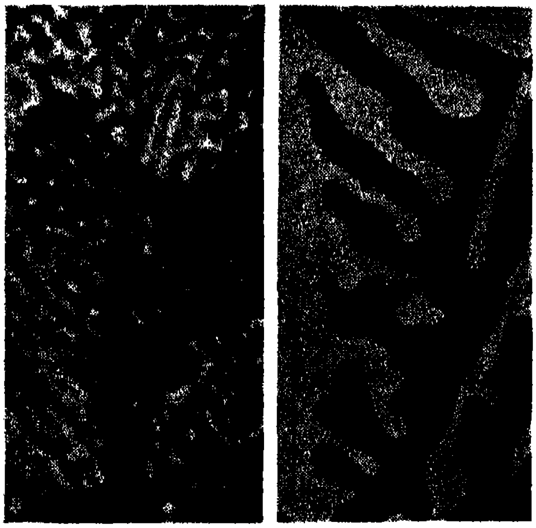

FIG. 1. The electron micrographs were made from a myosin sol originally dissolved in 0.5 M KCl. The aqueous film was frozen in liquid air and then dehydrated at −72°C. Note the total absence of any obscuring salt deposition.

A striking thing is that salt crystals have rarely been seen in material prepared by this method in spite of high tissue concentrations to begin with. Specimens which were relatively thick and bounded by membranes (as muscle fibers) undoubtedly retained their salt *in situ*, for even thin fragments had a high electron density. Single myofibrils, for example, were ordinarily quite opaque in spite of being less than 1 μ in thickness.

However, when one was dealing with a porous structure, the salt originally present disappeared in some undetermined manner. Thus, the intercellular "fluid" of loose connective tissue (perimysium has been most studied) showed a very low electron density. More dramatic and more definitive, though, were preparations made to study the structure of myosin sols. Aqueous films of purified myosin dissolved in KCl were frozen and dried as indicated. The salt concentrations were varied from 0.3–1.0 M. Although the details of the myosin structure will be described in a subsequent paper, it is necessary to point out here that the myosin was aggregated in long, fingerlike processes which often branched. Thus, a 3-dimensional network was formed, with a pore size that would be measured in only fractions of microns. That this mesh could offer delicate support is shown by Fig. 1. In these preparations there was never any trace of salt deposition, either in the interstices of the mesh or upon the myosin aggregates, and either in a crystalline form or in an amorphous mass. For all practical purposes the free and unbound salt had simply disappeared!

A special investigation would be necessary to determine where the salt goes under these circumstances. It would seem, however, that the phenomenon must depend upon the fact that one is dealing with ions that are fixed in a solid, yet are not associated in a crystal lattice. Conceivably the slightest jar after dehydration disperses them either as free ions or as molecules. But then one would expect that at least occasional masses would be caught and trapped in interstices such as are present in the myosin net. There was no evidence of this in porous structures, although there was within cells. The remaining possibility would seem to be that the ions (or perhaps molecules) literally evaporate from the regressing glass-ice surface during the dehydration. At first thought this latter suggestion would seem to run counter to physicochemical doctrine. But the author is not aware of any vapor-pressure work having been done on comparable systems in which isolated ions could be expected to appear on an evaporating solid surface. The attractive forces should be very different than at either a crystal face or a fluid surface, the ionic mobility being unimpaired in the latter. One may hazard the guess that the ionic or molecular vapor pressure may be quite appreciable at an evaporating glass-ice surface where isolated ions become exposed. If this latter hypothesis is the correct explanation of the observed phenomenon, it should be possible to find evaporated salt trapped or plated somewhere in the pumping system. It is likely that radioactive tracer techniques could be employed to good advantage to determine this. But in any case, aqueous systems containing high concentrations of salt can be prepared by this method for effective use with the electron microscope.

Incorporation of C^{14} From Carboxyl-labeled *dl*-Alanine Into the Proteins of Liver Slices[1]

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The source of energy for the formation of peptide bonds in living tissue is not known. Study of protein or peptide synthesis is hampered by the proteolysis which, in tissue outside the intact animal, always seems to predominate. Melchior and Tarver (*5*) have summarized the difficulties involved and have shown how they may be overcome by the use of tracers. The present paper describes preliminary studies of protein formation in liver slices, as measured by the incorporation of carboxyl-labeled alanine.

Carboxyl-labeled *dl*-alanine was prepared by the Strecker synthesis (*8*), with modifications appropriate for use of small amounts of radioactive hydrogen cyanide. The hydrogen cyanide was generated from potassium cyanide made by the method of Cramer and Kistiakowsky (*2*), with certain changes.

Eight-tenths gram of clean potassium was placed in a 10 mm. x 400 mm. Pyrex tube (capacity, about 14 cc.). This tube was attached to a vacuum line, and the potassium was shaken and distilled to form a continuous thin mirror over the entire inner surface of the tube. Approximately 2 millimoles of ammonia and the carbon dioxide from 8.5 mg. of radioactive barium carbonate (stated to contain 3–5 per cent $BaC^{14}O_3$) and from 179 mg. of nonradioactive barium carbonate were condensed in the reaction tube with liquid nitrogen. This tube, containing potassium, ammonia, and radioactive carbon dioxide, was sealed and placed in a steel bomb tube, which was inserted in an electric furnace. The temperature was raised to 620° C. in 8 minutes and was then held constant for 12 minutes. After cooling, the glass tube was removed and chilled in liquid nitrogen. The end of the tube was heated with a hot flame and the excess pressure released. The small amount of residual metal was decomposed with ethyl alcohol and water. After transfer to a generating flask on the vacuum line, and after preliminary evacuation, formic acid was added and the hydrogen cyanide distilled into a trap along with about 1 cc. of water. With inactive CO_2 the yield here was 90–96 per cent (average, 92 per cent).

The solution of hydrogen cyanide was transferred to a reaction flask along with 4 millimoles of ammonia and 2 millimoles of acetaldehyde and left overnight. Four cc. of 40 per cent hydrobromic acid was added and the solution boiled down to a paste during 4 hours. The paste was stirred at −40° C. with 3 cc. of methyl alcohol, filtered, and washed once with 2 cc. of cold methanol. The filtrate was neutralized with ammonium hydroxide. In order to recover the small amount of synthesized *dl*-alanine, 0.25 gram of ordinary *dl*-alanine was added, with heating. On cooling, 0.22 gram of carboxyl-labeled *dl*-alanine separated (m.p., 250° C. dec.; mixed m.p. with authentic pure sample, 250° C. dec.; activity 10 μc./mM).

Into Warburg flasks were pipetted 1–2 cc. of Krebs-Ringer phosphate solution (*3*, *9*) and 0.1–0.2 cc. of a solution of radioactive *dl*-alanine containing 0.86 mg. of *dl*-alanine/cc. If 0.1 cc. was added, the total activity per flask was about 21,000 counts/minute. Two-tenths cc. of 10 per cent potassium hydroxide was placed in each center well.

An adult Wistar rat was killed by decapitation. The liver was removed, and slices about 0.5 mm. in thickness were cut. The dry weight of each slice was 10–20 mg. Two to four slices were placed in each flask, the flasks then being attached to their manometers and the air washed out with either oxygen or nitrogen. After incubation at 37° C., with shaking, for varying lengths of time, the slices were removed and rinsed with two 20-cc. portions of water. They were then placed in a test tube, with 5 cc. of water, and homogenized with a glass pestle (*7*). After transfer to a centrifuge tube, 5 cc. of 20 per cent trichloracetic acid was added. After 15 minutes, the precipitated proteins were centrifuged and washed three times with 10-cc. portions of 10 per cent trichloracetic acid. One cc. of 6 N hydrochloric acid was added. Hydrolysis of the proteins was effected by autoclaving for 16 hours at a pressure of 20 pounds. One drop of 0.1 per cent phenol red was added, and the hydrochloric acid was neutralized with concentrated ammonia. The volume was adjusted to about 2 cc. The carboxyl groups were then split from the amino acids by reaction with ninhydrin, according to the method recommended by Van Slyke, MacFadyen, and Hamilton (*10*). In this procedure, 50 mg. of powdered citrate buffer at pH 2.5 and 50 mg. of ninhydrin were used. The boiling time allowed was 15 minutes. The carbon dioxide was distilled into 2 cc. of approximately 0.25 N barium hydroxide, and the amount of barium carbonate formed was estimated by titration with 0.1 N hydrochloric acid. After the distillation system had been filled with carbon dioxide-free air, the tubes containing the barium carbonate were removed, stoppered, and set aside for counting.

Measurements of the activity in the carbon dioxide evolved in the ninhydrin reaction were carried out by transferring the gas sample directly into an evacuated counter tube. The gas-counting technique has been recently described (*6*). Such a method is desirable here because the low specific activity of the sample would reduce the efficiency of measurement by standard solid sample—end-window counter techniques to a low value.

The barium carbonate was rinsed into a gas evolution flask attached to the vacuum line. The carbon dioxide was evolved by addition of dilute perchloric acid, swept by a slow stream of nitrogen into a trap cooled in liquid nitrogen, then transferred to a gas burette for measurement of the amount of sample, and finally transferred by distillation to an evacuated counter tube attached to the gas system with ground joint and stopcock. The dose of carbon disulfide vapor necessary for counting was added and the counter tube then detached from the gas system and placed in a lead housing for counting.

A sufficient number of counts was collected in each sample to make the statistical error less than the other errors of technique in the over-all procedure. The activities are reported as final corrected counting rates per minute in the samples (*6*).

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The data from the first series of experiments are given in Table 1. It may be seen that the incorporation of activity into the trichloracetic acid precipitable protein is a slow and continuing process that is dependent on the utilization of oxygen by the tissue. The low values obtained in nitrogen and after very short incubation periods serve as a check on the efficiency of the washing procedure and demonstrate that this uptake is not a simple adsorption on the protein structure. Presumably because of individual differences between tissue slices, the scatter of the data accumulated to date does not allow the shape of the curve of uptake with time to be determined. It could be expected to go through a maximum and fall toward zero, because the net over-all process is proteolysis.

TABLE 1

No. of slices	Activity added (counts/min.)	Vol. of liquid bathing slices (cc.)	Time	Gas phase	mM CO_2 derived from protein hydrolysate	Total counts/min. incorporated into protein
2	21,000	1.1	1 min.	Air	0.103	12
2	21,000	1.1	1 "	"	0.121	13
2	21,000	1.1	4 hrs.	Nitrogen	0.124	12
2	21,000	1.1	4 "	"	0.091	4
2	21,000	1.1	4 "	"	0.146	0*
4	42,000	2.2	4 "	"	0.147	0
4	42,000	2.2	4 "	"	0.189	20*
2	21,000	1.1	2 "	Oxygen	0.115	102
2	21,000	1.1	2 "	"	0.131	150
2	21,000	1.1	2 "	"	0.112	126
2	21,000	1.1	4 "	"	0.144	916†
2	21,000	1.1	4 "	"	0.125	160
2	21,000	1.1	4 "	"	0.102	166
2	21,000	1.1	4 "	"	0.146	76*
4	42,000	2.2	4 "	"	0.153	188
4	42,000	2.2	4 "	"	0.146	128*

* The pH of the liquid phase in these experiments was 6.96; that in all other experiments, approximately 7.25.

† This value is thought to be greatly in error. It is included in the interest of completeness.

Because of the variety of reactions in which alanine may participate, detection of activity in protein does not prove that alanine molecules, as such, have entered the peptide chain. Preliminary experiments, in which relatively large quantities of nonradioactive *dl*-alanine were added to a tagged hydrolysate and the alanine crystallized three times, do indicate that a large percentage of the activity in the hydrolysate can be accounted for as alanine. Small amounts of activity were found when similar crystallizations were conducted with *l*(+)-glutamic acid and with *dl*-aspartic acid. Whether this activity represents contamination with alanine cannot yet be stated. It would be expected, in the light of the recent work of Anfinsen, *et al.* (*1*) on the incorporation of activity from bicarbonate ion into the glutamic and aspartic acid fraction of protein, that a similar path to these two species would be available by way of pyruvic acid derived from alanine. No activity was found in glycine, the only other fraction so far investigated.

We regard as slight the possibility that activity has been incorporated by transcarboxylation with the original peptide chain, particularly in view of the reappearance of the activity in the alanine fraction. However, this possibility will be investigated with amino acids tagged elsewhere than in the carboxyl group.

Although the pathway by which alanine is incorporated into the proteins of liver slices remains obscure, it seems clear that under the present experimental conditions little or no incorporation is possible in the absence of oxygen. All experiments completed to date confirm this observation. This finding is compatible with theories of protein synthesis which postulate coupling with energy yielding reactions (cf. Lipmann, *4*).

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Isolation of Avian Pneumoencephalitis (Newcastle Disease) Virus From the Yolk Sac of Four-Day-Old Chicks, Embryos, and Infertile Eggs

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Beach (*1*) has reported the isolation of pneumoencephalitis virus from ovarian tissue of a hen, while Jungherr (*2*) and Van Roekel (*3*) have obtained the virus from fresh eggs. These findings show that the virus may be present in hatching eggs but do not provide evidence that it will survive the incubation period and result in chicks being infected when hatched.

In the experiments reported herein, the four-day-old chicks, the embryos, and the infertile eggs used for virus isolation trials were from parent stock known to be affected with pneumoencephalitis. The chicks were hatched from eggs obtained when egg production was severely depressed as a result of pneumoencephalitis. The embryos, from the same parent stock as the chicks, were from eggs collected when the hens were in the recovery period and the rate of egg production was returning to normal. The infertile eggs, from a second flock of breeders, were collected immediately prior to observed clinical evidence of infection, during the outbreak and through the recovery period.

The virus of pneumoencephalitis was isolated by chick embryo culture from the yolk-sac content of 6 four-day-old chicks and from embryos of the succeeding hatch dead on the 15th day of incubation.

Fifty eggs from the second breeding flock were incubated at this laboratory. The virus was isolated from the pooled contents of 13 eggs which were found to be infertile when candled on the 7th day. Twenty live embryos which were sacrificed and 17 chicks which were allowed to hatch were examined without evidence being found that the virus was present. The chicks remained normal during the 21 days they were held for observation, and their sera were negative when tested for hemagglutination-inhibition antibodies.

It is of interest that clinical evidence of pneumoencephalitis infection was not observed in the flock of four-day-old chicks until several days after the 6 birds from which the virus was isolated had been selected. Two additional lots of chicks from the same batch delivered to other farms were reported to have remained free from infection.

The isolation of pneumoencephalitis virus from the yolk sac of four-day-old chicks, chick embryos, and infertile eggs further emphasizes the possibility that hatching eggs may be a medium of transmission of the disease from breeding hens to their offspring.

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Antibacterial Action of Inactivated Ergosterol in the Guinea Pig and Man

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The antibacterial action, *in vitro*, of ergosterol and related substances has been reported (*3*). Of these substances, vitamin D (activated ergosterol) has found clinical use in tuberculosis and has often caused toxic symptoms (*1*, *2*, *4*).

In guinea pigs we have been able to show that inactivated ergosterol, like vitamin D (activated ergosterol), suppressed tuberculosis; unlike vitamin D, it never caused any toxic symptoms.

Twenty-two guinea pigs infected with virulent tubercle bacilli were injected with 20 mg. of inactivated ergosterol in oil, or 76 mg. vitamin D (viosterol) in oil, and 11 untreated pigs were used as controls. Following the injection of vitamin D up to several days, a change in the appearance of the guinea pigs receiving this substance was noted: their hair stood up, and the animals shivered, had diarrhea, refused food, and lost weight. No such change occurred after inactivated ergosterol injection. The tubercles present on autopsy were fewer in pigs treated with vitamin D than in the others.

In a second trial, infected guinea pigs received a larger dose of inactivated ergosterol (100 mg.) and less vitamin D (15 mg. D_2). These doses were repeated for three consecutive weeks, with untreated pigs as controls. In those receiving vitamin D_2 the changes outlined above occurred after each injection. No such changes were noted after the much larger dose of inactivated ergosterol. On autopsy there was more suppression of the tuberculosis in the guinea pigs treated with the larger doses of inactivated ergosterol than in those receiving smaller doses of vitamin D.

In man, 300–500 mg. of inactivated ergosterol were injected intramuscularly weekly in cases of pulmonary tuberculosis. Four cases treated thus for 6 months showed more improvement than could be expected by bed rest alone; there was retrogression and absorption of the predominantly exudative and productive disease, with conversion of the sputum to negative for tubercle bacilli (except one case with a cavity over 4 cm. in diameter).

The intravenous injection of inactivated ergosterol did not result in an exacerbation or local reaction, as seen after intravenous vitamin D application.

There were never any ill effects after injection of inactivated ergosterol, regardless of the route of injection or the type of lesion treated.

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Prothrombokinase and the Three Stages of Blood Coagulation[1]

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For four decades a two-stage theory of blood coagulation has held sway. Reviews and textbooks have clung to it for lack of agreement among investigators of the problem concerning further detail. But now sufficient unanimity is emerging to justify reformulation of the basic theory.

When plasma is diluted with distilled water and the pH brought between pH 5.0 and 5.5, the resulting euglobulin precipitate contains the essential core of the blood-clotting system. A solution of this euglobulin preparation clots promptly following the addition of ionic calcium. Even in this somewhat simplified form, the coagulation process can be shown to involve three distinct reactions:

(1) Prothrombokinase → Thrombokinase (in the presence of calcium)
(2) Prothrombin → Thrombin (in the presence of thrombokinase and calcium)
(3) Fibrinogen → Fibrin (in the presence of thrombin)

Evidence that blood plasma contains an inactive form of thrombokinase was available as early as 1916 (*2*); and Bordet long ago detected a preliminary reaction occurring before the development of thrombin (*1*). That these important concepts have gained ground so slowly has been due to difficulties both of interpretation and technique. Among the chief of these has been the lack of a satisfactory procedure for studying the activation of prothrombokinase. Progress toward this objective is included in the following preliminary report.

Bovine prothrombin was prepared by a method involving adsorption on magnesium hydroxide, particular care being taken to remove prothrombokinase. To prepare prothrombokinase, bovine euglobulin was heated at 51°C. for 16 minutes to remove fibrinogen, most of the prothrombin was then removed by two adsorptions with barium sulfate, and finally, after dilution with distilled water, the prothrombokinase was precipitated at pH 5.2–5.5.

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[1] This work, done during the tenure of a Life Insurance Medical Research Fellowship, was aided by grants from the James Hudson Brown Memorial Fund and the Fluid Research Fund of the Yale University School of Medicine.

When calcium chloride was added to a mixture of prothrombokinase and prothrombin, there was a latent period during which little, if any, thrombin was formed. This was followed by a period of accelerated thrombin formation. It was then shown that the latent period could be eliminated by preincubation of the prothrombokinase with calcium and, contrariwise, that this could not be accomplished by preincubation of prothrombin with calcium. This made it evident that the commonly observed latent period was concerned with the activation of prothrombokinase under the influence of calcium.

When thrombokinase so prepared was added to prothrombin, production of thrombin began not only without a latent period, but with maximal velocity, and then followed a die-away pattern. The quantity of thrombokinase added to a given amount of prothrombin determined the initial rate of activation. These findings are consistent with an enzymatic interpretation. The fact that thrombokinase can be measured by the initial rate of prothrombin activation suffices for present purposes.

To follow the activation of prothrombokinase satisfactorily, it was necessary to devise a three-stage procedure based on the following principles: (I) Calcium was added to prothrombokinase, and, at intervals, (II) samples were assayed for thrombokinase by adding them to tubes of prothrombin. After a two-minute incubation, in each case, (III) a sample was transferred from the prothrombin tube to a tube of oxalated fibrinogen.

The speed of coagulation was a measure of the amount of thrombin produced during the two-minute incubation, and thus of the initial rate of prothrombin activation. In this new three-stage procedure, it will be noted that the experimental steps correspond directly to the three stages of the theoretical formulation, and that each of the active factors, thrombokinase and thrombin, is estimated in terms of its defining property.

When the activation of prothrombokinase was plotted against time, the experimental points fell close to the theoretical curve for an autocatalytic reaction. Moreover, the acceleration effected by seeding with a small quantity of activated material was striking. When a thrombokinase preparation was heated at 60° C. for 10 minutes, there were drastic losses of both the power to activate prothrombin and the capacity to accelerate the activation of prothrombokinase. Pending further study and purification of prothrombokinase, the only conclusion drawn is that the activation of prothrombokinase involves an autocatalytic or chain reaction.

Further experiments showed that the concentration of calcium was important not only for the activation of prothrombokinase but also for the activation of prothrombin. These problems involving the role of calcium in blood coagulation and optimal calcium concentrations require further investigation.

As is well known, certain plasma derivatives which have been treated to develop their fibrinolytic capacity are also able to hasten the activation of prothrombin. However, Seegers and Loomis (*7*) obtained a fibrinolytic preparation which did not activate prothrombin. It can now be reported that active thrombokinase preparations failed to cause obvious fibrinolysis in 12 hours, although a control fibrinolysin preparation produced lysis in 5 minutes. Thus, thrombokinase and fibrinolysin (plasmin) appear to be distinct; however, further inquiry is desirable.

Prothrombokinase is not a new coagulation factor. Since the early work of Dale and Walpole several investigators have recognized its existence in plasma and have called it "prothrombokinase" or by a recognizably similar name. "Factor V" well could be included, although interpreted differently by Owren (*5*). In addition to this, prothrombokinase is undoubtedly a component of several diversely-named "blood-clotting factors" which have been independently disclosed in a variety of ways. The three-stage formulation has been implicit in the contributions of many workers and, in principle, is becoming more widely accepted (*3–6, 8*). Now that a direct three-stage method of analysis is available, it should be possible to decide whether a coagulant preparation contains prothrombokinase or thrombokinase. If this is not the fact, it should be possible to determine whether it accelerates the activation of prothrombokinase or favorably conditions the activity of thrombokinase.

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Growth *in Vitro* of Immature *Hordeum* Embryos[1]

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Experiments on the cultivation of immature plant embryos *in vitro* have met with varying success, depending on the age of the embryos used as well as on the species chosen. Most workers have found that only embryos already differentiated to some degree are able to grow on artificial media. Furthermore, in the case of older embryos, it has been observed by La Rue (*1*), working with *Zea* and *Avena*, and by others, that the plants obtained from excised embryos are smaller and weaker than those from mature seeds. This phenomenon appears to be related to the fact that an embryo removed from the seed and placed on nutrient agar tends to germinate immediately to produce a miniature seedling, rather than to continue the characteristic development leading to a fully grown embryo. Thus, the problem of growing young embryos appears to involve two interrelated questions: (1) how may the growth of young embryos be promoted, and (2) how may one bring about a continuation of the embryonic type of growth? It is with the latter aspect that this paper is particularly concerned.

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[1] Paper No. 371 from the Department of Genetics, College of Agriculture, University of Wisconsin.

Barley (*Hordeum vulgare* var. *Chevron*) is used as the experimental material in most of the studies. Greenhouse-grown plants provide the seeds from which embryos are aseptically removed. The basic medium contains distilled water, 2 per cent sucrose, 0.8 per cent agar, and the mixture of minerals used by Randolph and Cox (*2*). The pH of this medium is about 5.6; all of the supplemented media are adjusted with KOH and HCl to approximately the same pH. The cultures are kept in the laboratory at room temperature.

Immature embryos (about 10–15 days after pollination), when placed on the basic medium, regularly germinate within 2 or 3 days, forming seedlings of a normal appearance except for being smaller and more spindling than those from mature seeds; the younger the excised embryo, the weaker is the seedling. The transformation from embryo to seedling also finds expression in the percentage of dry matter: an embryo growing in the seed consists of about 40 per cent dry matter, whereas during 5 days on the basic medium the dry matter content of the seedling drops to about 10 per cent.

TABLE 1

GROWTH OF BARLEY EMBRYOS ON MEDIA CONTAINING VARYING AMOUNTS OF CASEIN HYDROLYSATE

Treatment	No. of embryos	Avg. wet wt. (% of control)	Avg. dry wt. (% of control)	Avg. dry matter (% of wet wt.)
Untreated				
Removed from plant at start of experiment......	6	4	17	35
Removed from plant after 5 days...	12	9	39	39
Grown *in vitro* for 5 days				
Casein hydrolysate (%)				
0 (control).....	11	100	100	10
⅛.......	10	141	147	10
¼.................	10	169	219	11
½.....	11	145	264	18
1........................	12	69	178	25
2........................	12*	21	95	36

* Four of this group died without appreciable growth.

The prolongation of embryonic growth (enlargement of the scutellum and continued development of the root and leaf primordia within their embryonic sheaths) may be brought about by addition to the basic medium of an "embryo factor" found, for instance, in casein hydrolysate. On a medium containing 1 per cent of vitamin-free acid hydrolysate of casein, germination is inhibited for several days in the case of embryos about 13–15 days old; the germination of 10- to 12-day embryos is delayed for longer and sometimes indefinitely. The embryos meanwhile undergo considerable enlargement so that sometimes their size exceeds that of normal, mature embryos. Lower concentrations of casein hydrolysate give correspondingly lessened effects. Table 1 shows the results of a typical experiment.

It can be seen from Table 1 that (1) all but the highest concentrations of casein hydrolysate increase both the wet and the dry weights relative to the control; (2) with the higher concentrations the dry weight increase is relatively greater than the wet weight increase, thus giving a steady increase in the percentage of dry matter; (3) in all cases the embryos grown *in vitro* weigh more (wet *and* dry) than the original embryos at the start; and (4) the artificially cultivated embryos are heavier than they would have been had they been left to grow on the plant for the same period.

Results of the same general nature may be obtained by using water extracts of dates and bananas, wheat gluten hydrolysate, lactalbumin hydrolysate, milk, and especially tomato juice. The tomato juice may be prepared by mincing fresh, ripe tomatoes (e.g. in a Waring Blendor), centrifuging and filtering the product, autoclaving the filtrate, and then refiltering to remove the precipitate which forms the first time the juice is autoclaved. Thereafter the juice is apparently unaffected by repeated heating. Attention is called to this source of embryo factor in particular because of its clear-cut effect not only on the 10- to 15-day embryos but also on those several days younger. Embryos 7–9 days old at excision show very irregular growth on the basic medium, varying from no observable change to weak germination, with occasional callus growth; however, when placed on a medium which has been made with one-third to two-thirds of the water replaced by tomato juice, these young embryos regularly enlarge in a fashion resembling normal embryo growth. A suggestion that this growth bears a physiological as well as morphological resemblance to normal growth is found in the fact that if the embryo is removed from the supplemented medium within about 2 weeks or less, germination soon occurs and the seedling formed is much stronger than one which has grown continuously on the basic medium. The growth rate after removal is so much greater than that of a control embryo that this latter is soon overtaken by the tomato-fed plant. In some cases, young embryos showing no growth on the basic medium may be induced by this method to form small seedlings.

Growth, particularly of the younger embryos (7–9 days), was also favored by the addition of sodium nucleate from yeast. The preparation which gave the best results was one from the Schwartz Laboratories, Inc., New York City. It was effective in concentrations from 2 per cent to at least as low as .25 per cent. It had no germination inhibiting effect, but produced stronger seedling growth. As with tomato juice, it supported the growth of embryos too young to survive on the basic medium. In one typical experiment in which length of shoot was used as a measure of growth, and the height of the control seedlings was taken as 100 per cent, the average value for 19 embryos grown on a medium supplemented with 1 per cent sodium nucleate was 210 per cent.

Little can yet be said regarding the nature of the ingredients which are active in promoting embryonic growth. One question for further investigation immediately presents itself: Is the embryo factor one substance causing an all-over morphogenetic effect, or is it, e.g. in the tomato juice, a combination of two factors, one of which inhibits germination, the other promoting growth of the young organism? In either case, the temporary maintenance of the embryonic type of growth by the addition of the substances discussed appears to be of importance in rearing strong plants from immature embryos.

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IN THE LABORATORY

A Simple Technic for Passage of Certain Viruses[1]

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In making a passage of a virus, the usual technic is to triturate an organ or tissue of an infected animal using a mortar, pestle, and abrasive. The ground tissue is suspended in a suitable diluent, centrifuged, and the supernatant used to subinoculate other animals. This procedure requires considerable sterile equipment and is time consuming. The purpose of this report is to describe a simplified method which has proved to be of value in subinoculating the viruses of St. Louis and Japanese encephalitis from the brains of experimentally infected mice and hamsters. The method is similar to that used to obtain specimens for culture of bacteriologically infected tissues, e.g. aspiration of buboes, and for microscopic examination of infected tissues, e.g. examination of biopsied brain tissue for exoerythrocytic stages of malarial parasites (*1*).

The technic consists merely of inserting a hypodermic needle, attached to a small syringe, through the disinfected skin, calveria, and into the cerebrum of the animal from which one desires to make the transfer, applying moderate suction with the attached syringe, and then inserting the contaminated needle intracerebrally in the same manner into a recipient mouse. The only equipment needed is the sterile syringe and needle. When more than one animal is subinoculated, the needle is reinserted into the "donor" cerebrum before each subinoculation.

Since the brains of mice infected with either of the viruses we have used (Hubbard strain of St. Louis encephalitis; Nakayama strain of Japanese encephalitis) are consistently infectious for mice in dilutions of 10^{-7} to 10^{-8} or higher, the technic described probably carries over many infectious units from an animal with a full-blown infection. In order to test the method a hypodermic needle was contaminated with St. Louis encephalitis virus by dipping it into a 10^{-1} dilution of infected brain emulsion. The needle was then inserted into the cerebrum of a mouse and withdrawn. Eight mice were inoculated in this way. All died with typical signs of St. Louis encephalitis.

Seven other mice were inoculated intracerebrally with a needle which had been contaminated with Japanese encephalitis virus by inserting it into the cerebrum of a mouse which had just died of an infection with that virus. All died with typical symptoms.

The success of the method is probably, in great part, dependent upon the presence of a high concentration of the infectious agent in the tissue to be subinoculated and a high degree of susceptibility of the animals used. We have tried the method with the Lansing mouse-adapted strain of poliomyelitis virus with little success. Subinoculations to 3 mice were made by this method from each of 9 mice paralyzed after intracerebral inoculation. The incubation period in the donor mice was 5 days or less, during which period the virus is present in the brain in the greatest concentration (*2*). In only two instances did the subinoculated mice develop poliomyelitis (one of three mice in each case) in a 21-day observation period. The failure of the method here was probably due to the relatively low concentration of virus present in the donor brains.

This technic may be used either with living or dead mice, but we have found its greatest use to be in the situation where a mouse is found dead without previously having shown signs of illness, or having shown indefinite signs. In attempts to isolate the encephalitis viruses from a variety of neural and extraneural tissues of infected hamsters (*3*), mice were injected intracerebrally with tissue emulsions in the usual manner. The tissue specimens were occasionally contaminated with bacteria or contained minimal amounts of virus, or both. Many mice died without showing typical signs of viral encephalitis, with obvious bacterial encephalitis, or after prolonged incubation periods. A passage from such mice was desirable in order to assist in the interpretation of the result, and the technic described proved to be advantageous in making such passages.

To date, a total of 171 successful passages of virus have been made with this technic from the brains of mice dying after intracerebral inoculation with various hamster tissue emulsions and from those of hamsters following intracerebral or extraneural inoculation. In 87 of the 171 instances the donor animal died without typical signs of viral encephalitis having been seen, although observations were made at least once a day. In these 87 instances it would not have been possible to establish the cause of death without passage. In 13 of the successful passages the subinoculations were done from animals showing signs of bacterial infection of the brain, resulting from a bacterially contaminated inoculum. The usual method of emulsifying the brain tissue mixes any bacteria present into the whole preparation and renders a bacteria-free passage inoculum impossible without careful centrifugation, filtration, or some other manipulation. The method described is particularly useful in such cases because one can avoid the usual localized abscess in the cerebrum by inserting the transfer needle into the opposite hemisphere from the original inoculation.

The technic described here has the advantage of simplicity and speed, and has proven of value in the application mentioned. It should be applicable to other viruses, or other infectious agents, that occur in tissues in high concentration.

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[1] Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

A Method for Permanent Identification of Materials Sealed in Small Containers

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Bacterial cultures, viruses, bacteriophages, and other materials which might be dried and sealed in small containers under the original vacuum are frequently kept for months or years before use. Methods commonly used for identification of such tubes, frequently only 7–10 mm. in diameter, are unsatisfactory. Gummed-paper labels are defaced or soak off during the customary preliminary freezing. If a spiral strip of paper is used, the contents of the tube may not be readily visible for inspection. Paper labels of any type are likely to become dry and frequently fall off during prolonged storage under varying conditions of humidity; furthermore, they are subjected to the attentions of the cockroaches and silverfish which are too frequently present in many laboratories. Adhesive tape is awkward to handle and difficult to write on. Scotch tape protects labels to some extent, but eventually dries. Writing on the container itself with wax pencil is impermanent, while the use of a diamond point introduces the possibility of weakening the glass. Most small containers do not afford sufficient area to permit inscribing adequate data.

Introduction of a marker into the tube before use is more satisfactory. Permanent identification can be afforded by colored "seed" glass beads now available at 5- and 10-cent stores. These beads, about 2 mm. in diameter and 1 mm. in height, can be obtained for about 15 cents per vial containing approximately 1,000 beads. Ten clearly differentiated colors are sold.

The beads are made of colored glass and do not change color after being subjected to autoclaving or treatment in the hot-air sterilizer. No toxic effect has been apparent. They can be introduced into the tube and sterilized with it or can be sterilized separately and put into the tube with aseptic precautions. The colors are readily visible after the culture or other material has been dried in the usual amounts.

A standard code for identification of cultures dried by lyophile, cryochem, or other processes would permit exchange of materials between laboratories and ready identification. By a suggested system, now in use, a single bead is assigned to each of the major groups as follows: red, *Clostridium*; purple, *Corynebacterium*; green, *Hemophilus*; blue, *Neisseria*; white, *Pasteurella*; yellow, *Salmonella*; brown, *Shigella*; black, *Streptococcus*; gold, bacteriophage; and silver, virus. Forty-five additional generic combinations can be made by using two beads, each of different color. The use of an indicator code for each genus reduces records to a minimum, permits rapid recognition, and will simplify correspondence.

Amplifying this system, the species is represented by two beads of the same color. With a single genus indicator bead, 10 species can be identified, using a total of three beads per tube. An additional 10 species can be identified by using three similarly colored beads with the single genus indicator color. When this possibility is exhausted, the number of combinations becomes greatly increased, since the addition of four beads to the genus indicator permits the possibility of representing the species by pairs differing in color from each other. If the genus is represented by two single beads of different colors, the 8 remaining colors are available for use in sets of two or more similarly colored beads to represent species. Beads differing in shape from those described are also available, permitting a large number of additional combinations.

The method is inexpensive, simple, and permanent. It can readily be adapted to materials other than those used by the bacteriologist. The use of larger beads would permit a permanent identification of materials dried in containers larger than those customarily used for bacterial cultures. The possibility of using beads of different size or shape to expand the code to include data on lot number, date, and other information will be apparent.

A Modified Warburg Vessel[1]

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The present method of introducing various substances into the main reaction mixture of a Warburg vessel has certain drawbacks. The usual method of transferring the contents of the side arm involves removing the manometer from the water bath, which inevitably causes temperature changes in the system. The contamination by KOH from the center well may also occur, and when 10 or more manometers are used in the same experiment, the procedure may take several minutes.

In order to eliminate these difficulties, the flask illustrated in Fig. 1 was constructed. In this flask the side arms are inserted in the main vessel by means of ground-glass joints and are attached with rubber bands. At the beginning of the experiment the side arms are placed in position 1. After temperature equilibrium has been reached, they may be turned to position 2 at any moment. The rubber band keeps the side arms fixed in either position.

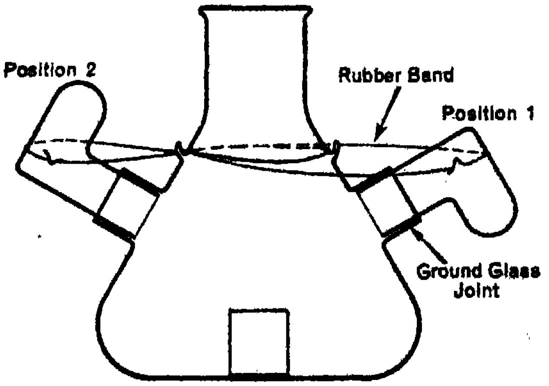

Fig. 1

This modified Warburg vessel enables one to add one or two substances to the main reaction mixture at any time during the experiment. The addition can be carried out quantitatively within a few seconds and without causing any temperature changes. The modified vessel may be used also for chemical microanalyses in which the determination of certain substances is based on gas reactions.

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[1] Aided by a grant from the Medical Science Section, Office of Naval Research, Navy Department.

Ureteral Catheter for Microinjection Tubing

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National Institute of Health, Bethesda, Maryland

In the usual arrangement for microinjection with the Chambers or Fitz micromanipulators, the syringe is connected to the needle holder by fine metal tubing (*1*). This tubing works satisfactorily during the actual injection, where the amplitude of movement is small, but is subject to fairly frequent breakage during the greater flexions which occur in cleaning, filling, and adjusting the apparatus. When the microinjection apparatus is used separately from the micromanipulator, as it has been in many investigations involving semimicrotransplantation (*2*), or injection of materials into insects or embryos, the frequency of breakage is increased. In addition, the not inconsiderable mechanical resistance offered by the metal tubing interferes markedly with the delicacy of manual operation which can be attained. These obstacles are still more troublesome with a glass capillary connector (*3*). Furthermore, suitable metal tubing is difficult to obtain and repair and is expensive.

We find that the above difficulties can be overcome completely by substituting ureteral catheter tubing for the metal or glass connector. This type of catheter, which is made of plastic-impregnated nylon, is inexpensive and, though extremely flexible, is very resistant to pressure, stretching, kinking, and breakage.[1] Moreover, snug connections to both syringe and needle holder can be made very simply by way of No. 24 hypodermic needles (with the points cut off square and smoothed), providing the basal end of the needle holder is turned down to the standard taper of the hypodermic needle hub.

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Improving the Performance of the Flame Photometer

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The following modifications of the Model 18 Flame Photometer (manufactured by the Perkin-Elmer Corporation) have been necessary to bring the performance of the instrument up to an excellent degree of precision and reliability.

The flame characteristics were improved by placing a Bunsen burner inside the original Meeker burner and permanently removing the grid on top of the latter. The installation requires no machining of any kind (Fig. 1). The alteration resulted in a more steady flame with both bottled and Ohio natural gas, irrespective of the gas-jet size.

Additional improvement was obtained by placing an ordinary 250-watt infrared lamp facing the right side of the photometer. The bulb serves to warm the air entering the atomizer by heating an improvized air filter and also warms the atomizer directly, as the door to its compartment is held permanently open. The increase in temperature permits a more rapid attainment of equilibrium within the vessel because of a greater degree of vaporization and a reduction in the excess condensation on the walls of the atomizer.

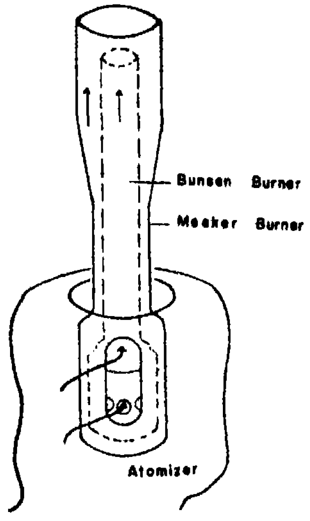

Fig. 1

A Sensitive Cylinder-Plate Assay for Bacitracin

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A cylinder-plate assay is desirable for practically any type of antibiotic work because it is not readily disturbed by slight bacterial contamination, it readily reduces to routine handling by technicians, and it is less time consuming than other assays.

The assay of bacitracin previously described by Johnson, *et al.* (*2*) was a 72-hour dilution assay using *Streptococcus hemolyticus* (Chanin strain). For our preliminary research work on bacitracin, *Staphylococcus aureus* was used as a cylinder-plate assay organism, but its relative insensitivity and rather "fuzzy-edged" zones limited its usefulness.

During the examination of the spectrum of bacitracin four rather sensitive organisms were found which gave good growth on a plate: *Micrococcus flavus*, isolated from the laboratory air; *Gaffkya tetragena* ATCC #6007; *Sarcina flava* ATCC #540; and *Sarcina lutea* ATCC #272. Experiments using each one of these organisms showed *M. flavus* to be superior because of the smoothness of growth and sharp, even edges of the inhibition zones.

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[1] Size "French 4" ureteral catheter, American Cystoscope Makers, Inc., 1241 Lafayette Avenue, New York City. These catheters are approximately 64 cm. long, 1.35 mm. o.d., and 0.5 mm. i.d.

The assay as finally developed uses *M. flavus*[1] as the assay organism; a culture of this has been sent to the American Type Culture Collection (ATCC #10240). The inoculum is developed by inoculating 60 ml. of "Bacto Yeast Beef Broth"[2] *(1, 3)* in a 300-ml. Erlenmeyer flask by means of a loop from an agar slant culture. The flask is incubated at 37°C. while being shaken on a machine at 126 oscillations/minute with a 1½-inch stroke. This procedure gives a heavy growth of organisms; static inoculum culture gives poor and grainy plate growth.

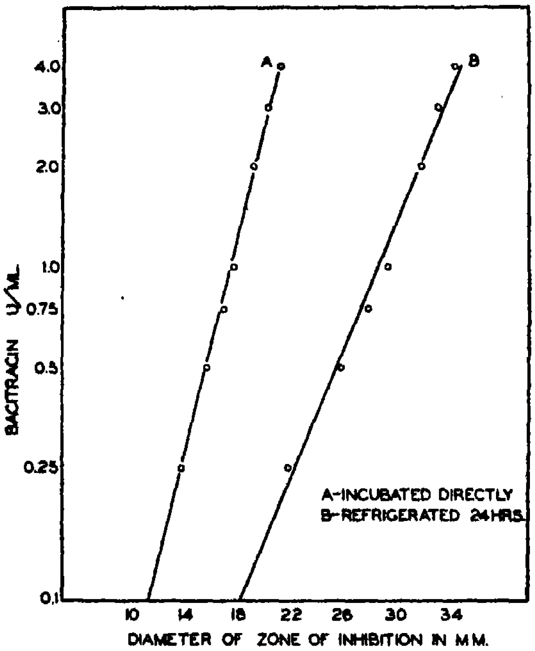

FIG. 1. Response of *M. flavus* to graduated doses of bacitracin on a cylinder-plate assay procedure: A, response curve when plates are incubated at 37°C. immediately after dosing; B, response curve when plates are held in refrigerator 24 hours before incubating at 37°C.

Plates are poured aseptically in the morning, using a Brewer Automatic Pipetting Machine, with 20 ml. of "Bacto Penassay Seed Agar"[3] *(3)*. By this method a large number of plates can be rapidly and accurately poured.

In the afternoon the seed layer is poured, using the same kind of agar as the base layer, inoculated with 1 per cent of the 18-hour inoculum broth. Four ml. of seeded agar at 50°C. is used per plate, and the plate rapidly tipped to distribute the layer evenly. Stainless-steel cylinders are placed with a dispenser (made by Robert D. Shaw, Bloomfield, Connecticut) after the agar has gelled but before it has become very hard (15–20 minutes after pouring).

The cylinders are filled with the sample, diluted to approximately 2 units/ml. with sterile, 1 per cent phosphate buffer[4] of pH 6.5. Two cylinders on each plate are filled with a standard bacitracin solution of 2 units/ml., and two cylinders on the same plate are filled with the unknown solution, after which the plates are covered with "Coors" porous porcelain covers, not raised. The plates are incubated directly at 37°C. for 16–18 hours. The zones of inhibition are then read by projecting the image of the plate onto a screen by means of an overhead-type lantern-slide projector. The screen is ruled, and the diameters of the inhibition zones are read and recorded. The units/ml. for each sample are then calculated on a slide rule constructed from a standard curve prepared previously by plotting on semilog paper averages of 100 readings/dosage level, 0.1–4 units/ml. (Fig. 1). That the day-to-day variation on the curve is not usually excessive is demonstrated by Table 1. The variation when responses with different batches of media are compared may be slightly greater.

TABLE 1

DAY-TO-DAY RESPONSE OF *Micrococcus flavus* TO BACITRACIN

	Average diameter of zone of inhibition in mm.				
	0.1 u./ml.	0.5 u./ml.	1.0 u./ml.	2.0 u./ml.	4.0 u./ml.
1st day	11.3	16.2	17.7	19.3	21.0
2nd "	11.6	16.1	18.1	19.4	21.6
3rd "	11.2	16.3	17.9	19.3	21.4
Average	11.3	16.2	17.9	19.3	21.3

The slope of the curve is less than for penicillin, since there is approximately a 1.7- to 1.9-mm. increase in zone size per doubling of dose. This slope can be increased to 3.0 or better by refrigeration of the dosed plates 16–18 hours before incubation. The precision of the assay is not greatly increased, however, because the variation of zone diameters increases. The penicillin curve gives a slope of 3.2 without refrigeration. This difference in slope is a reflection of the relative speeds of diffusion of the two substances, the refrigeration procedure giving bacitracin a greater time for diffusion. For results in which reasonably high significance is needed, 4 plates (*i.e.* 8 zones) are averaged to give the assay; for final lots for clinical use, 8 plates are used.

The assay can be used for blood serum assays. Dilutions made up in fresh rabbit serum and in horse serum gave values within 10 per cent of the known. Attempts to extend the range of the assay below 0.1 unit/ml. by preliminary refrigeration have not given reliable results.

Common organic solvents used in recovery, such as butanol, ether, ethanol, etc., do not interfere with the assay when diluted 1/20 or greater. Bacterial contamination, unless excessive, does not interfere; bacitracin beer samples, for instance, are simply centrifuged for 20 minutes at 2,000 × g, which reduces the bacterial population in the supernatant sufficiently to allow a satisfactory assay.

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[1] Identified by Robert S. Breed at the New York State Agricultural Experiment Station, Geneva, New York.

[2] Medium II of Schmidt and Moyer *(3)* as reported by Food and Drug Administration *(1)*; manufactured by Difco Laboratories, Detroit, Michigan.

[3] Medium I of Schmidt and Moyer *(3)* as modified by Food and Drug Administration *(1)*; manufactured by Difco Laboratories, Detroit, Michigan.

[4] The composition of the buffer is: K_2HPO_4, 4.43 grams; KH_2PO_4, 5.57 grams; distilled water to 1 l.

Book Reviews

Fishes of the Pacific Coast of Canada. Wilbert A. Clemens and G. van Wilby. (Bull. LXVIII.) Ottawa: Fisheries Research Board, 1946. Pp. 368. (Illustrated.) Paper, $1.50; cloth, $2.00.

For most of the seas of the world there are no comprehensive books on fishes which are useful to both ichthyologists and nonspecialists. The present volume fills that need for one large ocean area. Every species of fish which has been reported from the west coast of Canada is included. The fish fauna of the Northeast Pacific is so homogeneous, however, that the book will be most useful to anyone interested in the fishes which occur between Monterey Bay, California, and the Aleutian Islands, Alaska.

Identification keys for all of the species are included. There is a well-done, full-length illustration of each kind of fish, newly prepared by F. L. Beebe. Each species is adequately described in the test, and such information as is available about its life history and habits is briefly noted. There is an extensive glossary of the descriptive terms used, which will be useful to nonspecialists who are consulting other fish books. A bibliography of scientific papers on British Columbia fishes is given, followed by a list of general reference books on fish.

The work presented in the book is based on years of field experience with the forms described and is of high quality from an ichthyological standpoint. The system of classification adopted is modern, but on the conservative side and with little attention paid to taxonomic categories below the species level.

W. M. Chapman

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What is psychology? Werner Wolff. New York: Grune & Stratton, 1947. Pp. xii + 410. (Illustrated.) $4.00.

Although the chapter headings in this book are similar to those found in most general psychology texts, the topics discussed and the data presented are evaluated from the "organismic" point of view which ". . . considers man's behavior not as a fixed arrangement but as a dynamic system; the total behavior is more than the sum of its parts, a directing center being the resultant of functional relationships." In view of the author's theoretical bias it is not surprising that the researches presented in greatest detail are those done in his laboratory as well as in those of other gestaltists. One may wonder if the first-year student reading this book will come away with the impression that the problems with which gestaltists concern themselves are peculiar to that approach alone.

If, as the author states, the aim of this book is to make the student aware of the need for a questioning attitude, might it not be advisable to start with a study of the way in which we use words in questioning, formulating, and analyzing a statement? For example, in his discussion of perception Wolff says: "How can we unite the opposite theses that things actually are as they basically look to us, and that things are not as they look but reflect our imagination?" The reviewer is puzzled by what Wolff means by "actually," "basically," "reflect," etc. Are we referring to the same phenomena when we use the same words? It should be noted that neglect of the study of the function of language is a characteristic of practically all psychology texts.

The chapters on Depth Psychology and Personality present the data in these areas in a more rounded fashion than do most psychology texts; however, devoting two and a half pages to "techniques and aims of Depth Psychology" is likely to give a distorted picture.

The first-year student will probably find this book interesting and stimulating. Representing as it does a particular theoretical orientation in psychology, it should be used in conjunction with other texts with different approaches.

Seymour B. Sarason

Yale University

Guide to the literature of mathematics and physics including related works in engineering science. Nathan Grier Parke, III. New York-London: McGraw-Hill, 1947. Pp. xv + 205. $5.00.

Despite the fact that mathematics, physics, and their applications in engineering are among the oldest of the sciences, their voluminous literature has been, and still is, difficult to get at. The student of these sciences, beginner and specialist alike, and the librarian who, except in rare cases, is not acquainted with these subjects have long needed a guide to publications in these fields. This need has now been admirably met by Nathan Grier Parke, III, of the Massachusetts Institute of Technology. As a matter of fact, useful as this work will be to the expert. it will prove a real boon to that fast-growing army of workers in other sciences who must use mathematics and physics as tools in their own work.

The book begins with a chapter on the principles of reading and study which is followed by chapters on self-directed education, how to conduct a literature search, and how to use periodicals. The directions given are clear and concise, and the reviewer feels that, based upon his experience in the Reference Department of the world's greatest library, even specialists in the physical sciences will profit from reading the first half of Prof. Parke's guide.

In the second half of his book, roughly more than half the volume, the author presents a list of some 1,800 works in mathematics, physics, and related subjects representing, in fact, a carefully selected library in these subjects. Indeed, about half the titles are represented in Dr. Parke's personal library, while the rest were selected from a study of review journals and catalogues and by checking the reference shelves of such collections as those at Johns Hopkins, M.I.T., and the Library of Congress. Not only standard works in English, but also many in French, Italian, and German are listed.

Preceding the list of titles is a classification of the subject matter of the text. The references, however, are arranged under an alphabetical list of subject headings which, while it does permit of indefinite expansion, does not bring all relevant material together. In fact, it is not quite clear why Dr. Parke, having constructed a classification, did not use it, simply adding an alphabetic relative index as a key. Access to the titles by author is provided through an author index.

The book on the whole is well produced although the use of lower-case type for the subject headings is somewhat annoying.

As a librarian I am grateful to Dr. Parke for his valuable guide. I believe that all who use his book will express a similar sentiment.

MORRIS C. LEIKIND

Library of Congress, Washington, D. C.

Dynamic aspects of biochemistry. Ernest Baldwin. New York: Macmillan; Cambridge, Engl.: at the Univ. Press, 1947. Pp. xviii + 457. $4.00.

The author has devoted this text to enzymes (5 chapters) and metabolism (11 chapters).

The chapters on enzymes cover this field very well. Groups of enzymes are discussed which usually receive little attention. One could wish that the author had summarized all the chapters as was done in the case of the first two.

In the chapters on metabolism, the role of individual amino acids is featured. In the opinion of the author the end product of nitrogenous metabolism is based on the availability of water to the organism. Emphasis is placed on adenosine triphosphate as the only source of energy that can be directly utilized by living organisms.

The close resemblance of the carbohydrate metabolism of yeast and muscle is discussed.

The author has accepted as fact that virus proteins can "reproduce." So far as one of these proteins is concerned, it has been shown that it can be "sterilized" by appropriate means without loss of any of its physicochemical properties.

The text is well written, in simple, clear language and should be a requirement for every graduate student in the field of biological chemistry.

WILLIAM H. WELKER

University of Illinois College of Medicine, Chicago

Scientific Book Register

CHRYSLER, M. A., and EDWARDS, J. W. *The ferns of New Jersey.* New Brunswick, N. J.: Rutgers Univ. Press, 1947. Pp. vii + 201. (Illustrated.) $4.00.

COPELAND, EDWIN BINGHAM. *General Filicum; the genera of ferns.* (*Annales Cryptogamici et Phytopathologici*, Vol. 5, Frans Verdoorn, Ed.) Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1947. Pp. xiv + 247. (Illustrated.) $6.00.

DAVIES, OWEN L. (Ed.) *Statistical methods in research and production, with special reference to the chemical industry.* London-Edinburgh: Oliver and Boyd, 1947. Pp. xi + 292. 28/-.

DAVIS, HALLOWELL, *et al. Hearing aids: an experimental study of design objectives.* Cambridge, Mass.: Harvard Univ. Press, 1947. Pp. viii + 197.

GOLD, HARRY, *et al.* (Eds.) *Cornell conferences on therapy.* (Vol. II.) New York: Macmillan, 1947. Pp. xx + 354. $3.75.

HOUGEN, OLAF A., and WATSON, KENNETH M. *Chemical process principles.* Pt. II: *Thermodynamics.* New York: John Wiley; London: Chapman & Hall, 1947. Pp. xlvii + 437–804. $5.00.

HUTCHINSON, J. B., SILOW, R. A., and STEPHENS, S. G. *The evolution of Gossypium, and the differentiation of the cultivated cottons.* (Empire Cotton Growing Corp.) New York: Oxford Univ. Press, 1947. (Illustrated.) $4.25.

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Preview of the 114th Meeting, AAAS:

Chicago, December 26–31, 1947

General Information

Sixty-five Association sections and affiliated societies will present programs at the Chicago meeting. In addition, meetings have been scheduled for the organization of two new scientific societies, one in the field of systematic zoology and the other in the field of the social and economic sciences, specifically the study of invention. Other groups, such as the Natural Resources Council of America, Grassland Research Foundation, and Ecologists' Union, are meeting jointly with related societies.

The physical arrangements for the meeting were made with the help of Fred Puffer, of the Chicago Convention Bureau, and local committees; in several cases arrangements were made by representatives of the cooperating societies. Through the Convention Bureau the Association obtained commitments for about 4,000 hotel rooms. Commitments for session rooms were obtained from the sales managers of the Blackstone, Congress, Palmer House, Sherman, and Stevens Hotels. Officers of The University of Chicago generously provided meeting rooms for societies desiring to meet on the campus of the University. In every case, societies having closely related interests have been assigned meeting rooms in the same or adjacent hotels, in order that their members may mingle conveniently with a minimum of outdoor travel.

The following institutions in the Chicago area named representatives to organize the local committees: Chicago Academy of Science, Chicago Historical Society, Chicago Natural History Museum, Chicago Technical Societies Council, DePaul University, Elmhurst College, George Williams College, Illinois Institute of Technology, Lake Forest College, Museum of Science and Industry, National College of Education, Northwestern University, Roosevelt College, Saint Xavier College for Women, John G. Shedd Aquarium, University of Chicago, University of Illinois, and Wheaton College. At a meeting of committee members early in 1947, Paul Jenkins, secretary of the Chicago Technical Societies Council, was elected general chairman. His tasks have been to coordinate the activities of the subcommittees and to serve as their intermediary with the administrative officers of the Association. The five subcommittees are: *Finance*: W. P. Cortelyou, Roosevelt College, chairman; Gilbert A. Force, Illinois Institute of Technology, treasurer; *Equipment*: R. T. Van Niman, Chicago Technical Societies Council, chairman; *Publicity*: Jeannette Lowrey, The University of Chicago, chairman; *Reception and Entertainment*: Margaret Scriven, Chicago Historical Society, chairman; *Registration*: Hans O. Hoeppner, The University of Chicago, chairman. The general functions of these committees include raising funds to defray local committee expenses, providing equipment for the meetings of the sections and societies, aiding in the direction of press room activities, arranging for the general reception, and facilitating registration.

Reservations for sleeping accommodations may yet be made through the AAAS Reservation Center, Chicago Convention Bureau, 33 N. La Salle Street, Chicago 2. When writing for reservations, give your home address, dates of arrival and departure, and three hotels in order of preference. The hotel headquarters for all sections and societies meeting with the Association follow:

The Sherman Hotel will be the general headquarters of the Association, housing the Press Room (Parlors L, M, and O) and the business meetings of the Association.

Congress Hotel: American Association of Economic Entomologists, American Microscopical Society, American Society of Naturalists, American Society of Parasitologists, Beta Beta Beta, Ecological Society of America, Entomological Society of America, Society for the Study of Evolution, Society of Systematic Zoologists.

Continental Hotel: Econometric Society.

Palmer House: Section B (Physics), Section O (Agriculture), American Association of Physics Teachers, American Dietetic Association, American Meteorological Society, American Physical Society, American Society for Horticultural Science, Honor Society of Phi Kappa Phi, Philosophy of Science Association, Pi Lambda Theta, Potato Association of America, Society for Research in Child Development. (Meetings of Section B, American Association of Physics Teachers, American Meteorological Society, and American Physical Society will be held on the campus of The University of Chicago.)

Sherman Hotel: Section A (Mathematics), Section C (Chemistry), Section D (Astronomy), Section E (Geology and Geography), Section H (Anthropology), Section I (Psychology), Section K (Social and Economic Sciences), Section L (History and Philosophy of Science), Section M (Engineering), Subsection Nd (Dentistry), Subsection Nm (Medicine), Subsection Np (Pharmacy), Section Q (Education), American Chemical Society (Chicago Section), American Nature Study Society, Cooperative Committee on Science Teaching of AAAS, National Association of Biology Teachers, National Science Teachers Association, Pi Gamma Mu, Research Council on Problems of Alcohol, Sigma Delta Epsilon, Society of the Sigma Xi.

Stevens Hotel: Section F (Zoology), Section G (Botany), American Fern Society, American Phytopathological

Society, American Society of Plant Physiologists, American Society of Professional Biologists, American Society of Plant Taxonomists, American Society of Zoologists, Biometric Society (Eastern North American Region), American Statistical Association (Biometrics Section), Botanical Society of America, Inc., Genetics Society of America, Herpetologists League, Limnological Society of America, Mycological Society of America, Phycological Society of the Americas, Sullivant Moss Society.

The main registration center will be located adjacent to the Exposition Hall in the Stevens Hotel and will be open from 8:30 A.M. to 9:00 P.M. daily. Hours for *supplementary registration desks* in other hotels are: *Congress Hotel*, Monday and Tuesday, December 29 and 30, 8:30 A.M. to 5:00 P.M.; *Palmer House*, Monday and Tuesday, December 29 and 30, 8:30 A.M. to 5:00 P.M.; *Sherman Hotel*, Friday, December 26 through Wednesday, December 31, 8:30 A.M. to 9:00 P.M.

The registration fee is $2.00 for members and college students and $3.00 for nonmembers. Upon payment of the correct registration fees, members and guests will receive copies of the *General Program* and Convention Badges. Display of the AAAS Convention Badge is required for admission to the scientific sessions of nearly all sections and societies.

Advance registrants who have received their programs and badges prior to the meeting are asked to call at the AAAS *Information Desk* in the main registration area, in the Stevens Hotel, where maps and special literature may be obtained which will guide the visitor about Chicago. Other desks for the sale of meal tickets for breakfasts, luncheons, and dinners sponsored by the affiliated societies will be found in the main registration area, as well as booths for the distribution of tickets to entertainment features. Persons who did not receive definite hotel reservations at the time of advanced registration should, on their arrival, notify the attendant at the Information Booth in the Stevens Hotel of their local addresses for posting in the Visible Directory.

The Visible Directory will be located in the Stevens Hotel, basement elevator lobby, adjacent to the registration desks, and will be open for inspection 24 hours a day. The Registration Cards of all who register will be in the Visible Directory.

Mail and telegrams addressed in care of the AAAS will be delivered by the Post Office and wire services to the AAAS Information Desk in the Stevens Hotel. While every effort will be made to notify addressees who are listed in the Visible Directory, the Association assumes no responsibility for the delivery of mail and telegrams. Items not called for will be returned to the sender at the close of the meeting, December 31. Telephone and personal messages will be filed alphabetically at the AAAS *Information Desk*, which may be reached by telephone through the Stevens Hotel.

Transportation facilities are abundant in Chicago—streetcar, bus, subway, elevated, and taxi. Economical travel in the "Loop Area," in which most of the meetings will be held, may be made for 10¢ car fare. Maps of the "Loop Area" will be available for ready orientation (see General Program). Members of societies meeting on the campus of The University of Chicago may travel from the "Loop" to the 59th Street Station on the Illinois Central Railway at a fare of 11¢ one way, 20¢ round trip.

Press Service. All persons who will deliver addresses or present papers at the Chicago meeting are requested to provide the Press Service with copies of abstracts of their papers as far as possible in advance of the meeting. Complete manuscripts are required of papers presented by *officers* of the Association and by *officers* and *invited speakers* appearing on the programs of the affiliated and associated societies. All abstracts and manuscripts available in advance of the meeting should be sent to the AAAS Press Director, Dr. Sidney Negus, Medical College of Virginia, Richmond, preferably before mid-December, so that copies may be mailed to the science writers in time for them to examine and interpret the subject matter and to seek authoritative advice if necessary.

The Press Room at the Chicago meeting will be in the Sherman Hotel, Parlors L, M, and O, and will be equipped with duplicating machines to reproduce copies of papers delivered to the Press Director during the meeting, as well as with tables, bulletin boards, telephone outlets, reference texts, etc., to facilitate the work of the science writers. A pneumatic tube system for handling wire service is installed in the Sherman Hotel.

AAAS Business Sessions

The Executive Committee of the Association's Council will hold its first session in the Administrative Secretary's suite at the Sherman Hotel at 10:00 A.M. on Saturday, December 27.

The Council of the Association will meet on Sunday, December 28, at 3:00 P.M., in the Club Room of the Sherman Hotel. A second session of the Council will be held in the Club Room at 9:00 A.M. on Tuesday, December 30.

The Academy Conference will be held in Room 110, Sherman Hotel, at 4:00 P.M. on Saturday, December 27. Conferees will discuss the development of scientific personnel for industry and educational institutions, full subsistence science scholarships, the influence of academies on better science teaching, and the obligation of the State Academy to the Junior Academy. At 6:00 P.M. the group will attend the Academy Conference Dinner sponsored by the AAAS.

AAAS Prize Awards

The Annual One Thousand Dollar Prize, established in 1923, will be awarded to the author of a notable contribution to science presented on a regular program of the Chicago meeting. The Prize will be awarded upon the recommendation of the Prize Committee: Fernandus Payne (zoology), Indiana University, chairman; Malcolm Dole (chemistry), Northwestern University; A. J. Dempster (physics), The University of Chicago; and William R. Taylor (botany), University of Michigan. It is not necessary that the prizewinner be a member of the Association. All papers appearing in the *General Program*, except presidential and vice-presidential addresses and invited papers, are eligible for the Prize.

The AAAS-George Westinghouse Science Writing Awards will be presented at a ceremony to be held in the West Ballroom of the Stevens Hotel at 6:15 P.M. on Saturday, December 27. Awards of $1,000 each will be made to two writers, one for superior science reporting in newspapers, the other for an article on science published in a magazine. The judges of the awards are: H. L. Mencken, of the Baltimore *Sun* papers; Benjamin M. McKelway, editor, Washington *Star*; Edward Weeks, editor, *Atlantic Monthly*; Clifton Fadiman, literary critic; Rudolf Flesch, author of *The art of plain talk*; Kenneth Olson, dean, Northwestern University School of Journalism; Edward Weidlein, director, Mellon Institute; Detlev W. Bronk, chairman, National Research Council; and Morris Meister, principal, Bronx High School of Science, chairman of the Committee of Judges.

The First International Salon, "Photography in Science," sponsored by *The Scientific Monthly* and the Smithsonian Institution, is under way. For judging on October 27, competitors from 38 states and 3 foreign countries submitted 361 prints, 243 in the black-and-white division and 118 in the color division. Most of the prints were on display during November in the Arts and Industries Building of the Smithsonian Institution of Washington. During the Chicago meeting they will be shown at the International Science Exhibition in the Stevens Hotel. Later they may be seen at the Buhl Planetarium, Pittsburgh, and at the Cranbrook Institute of Science, Bloomfield Hills, Michigan. In the color division first place was awarded to Thomas C. Poulter, Armour Research Foundation; in the black-and-white division first place went to Edwin R. Willis, The Ohio State University.

AAAS Special Sessions

At each of its annual meetings the Association schedules a number of special sessions for the presentation of broad surveys of important fields of science. On Saturday morning, December 27, the Office of Naval Research (ONR) will present a report to scientists on research and Navy policy, Admiral Paul F. Lee, Chief, ONR, presiding. The ONR-University sciences programs will be reviewed, followed by a discussion led by Karl T. Compton, president of M.I.T.

On Saturday afternoon, December 27, the annual National Geographic-AAAS illustrated popular lecture will feature Harold F. Weaver in a report of the Brazilian Eclipse Expedition. Colored motion pictures will show the total eclipse of the sun and the preparations made by the Expedition to observe it in Brazil.

James B. Conant, president of Harvard University, will deliver his address as retiring president of the Association, on Saturday evening, December 27. The subject of Dr. Conant's address will be, "The Role of Science in Our Unique Society." Members of the Executive Committee of the Association and eminent scientists and citizens of Chicago have been invited by the Local Committees to be present on the Speaker's Platform. Following the address, the officers of the Association and the Chicago hosts for the occasion will receive members and guests at a general reception to be held in the Louis XVI Room of the Sherman Hotel. All members and guests of the Association are cordially invited to attend the Presidential Address and the Reception which will follow it.

On Sunday evening, December 28, the AAAS Cooperative Committee on Science Teaching will present a forum on "The Effectiveness of Science Teaching." The forum is based on a report by the Committee to the President's Scientific Research Board. Topics to be discussed will be the shortage of scientific personnel, particularly of science teachers, and methods for making up the deficiencies. Karl Lark-Horovitz, General Secretary of the Association and chairman of the Cooperative Committee, will preside. The panel of participants includes Philip Powers, R. W. Lefler, Morris Meister, Raleigh Schorling, Glen Blaydes, and L. V. Domm.

A full day's symposium on "Science in National Affairs" has been arranged for Monday, December 29. At the morning session, which will be devoted to "Atomic Energy Developments," W. Zinn will discuss "Developments of Atomic Energy at the Argonne National Laboratory"; L. J. Haworth will report on "The Brookhaven Laboratory and Plans for Fundamental Research in the Atomic Energy Commission"; Paul Aebersold will discuss "Radioactive Isotopes and Their Application to Peacetime Use of Atomic Energy"; and Philip Morrison will give an "Appraisal of Atomic Energy Progress."

The Monday afternoon session has been built around the President's Scientific Research Board Reports. E. U. Condon, National Bureau of Standards, will interpret the reports in relation to the "Federal Research Program in the Civilian Agencies." L. R. Hafstad will report similarly on the "Federal Research Program in the Armed Services." W. W. Lambert and D. W. Bronk will describe, respectively, "The Administration of Federal Research" and "The National Medical Research Program."

National Welfare and Science will be the theme of the evening session on "Science in National Affairs." J. Donald Kingsley, will speak on "Scientists and Federal Research," followed by W. W. Waymack, member of the

U. S. Atomic Energy Commission, whose subject will be "Scientists and the Atomic Energy Program."

On Tuesday morning, December 30, a symposium on "Insuring Adequate Scientific Personnel Resources" will be presented under the auspices of the National Security Resources Board, Executive Office of the President. The schedule of titles includes "Forecasts of Probable Supply and Demand," by Ewan Clague, Bureau of Labor Statistics; "Programs for Full Utilization of Present Resources," by A. H. Hausrath, Office of Naval Research; "Promising Innovations in University Programs to Meet Current Demands," by A. B. Bonds, Jr., President's Commission on Higher Education; and "Needed Adjustments in University Plans and Programs to Meet Long Range Needs," by Arthur Adams, Provost, Cornell University.

On Tuesday evening, December 30, the AAAS-Sigma Xi lecture will be presented by Glenn T. Seaborg in the Grand Ballroom of the Sherman Hotel. Dr. Seaborg will address the meeting on "The Eight New Synthetic Elements."

Programs of the AAAS Sections and the Societies

Section A (*Mathematics*) and the *Institute of Mathematical Statistics* will meet jointly in sessions for contributed papers on Monday and Tuesday, December 29 and 30. R. E. Langer, retiring vice-president of the Section, will present an address on "The Solution of Differential Equations in the Presence of Turning Points" at the Monday afternoon session.

Section B (*Physics*) will present two symposia jointly with the *American Physical Society* on Monday and Tuesday, December 29 and 30: "High Altitude Research by Rockets" and "The Physics of Polymers of Biological Interest." On Tuesday afternoon, L. A. DuBridge, retiring vice-president of the AAAS and chairman of Section B, will speak on "The Physics of Radar." In addition to contributed papers, the program of the American Physical Society includes invited papers of the Division of High-Polymer Physics. Among titles selected at random from the program of the APS are: "Beta Spectra of Cu(64) as a Test of the Fermi Theory," "Introduction of Two Neutrons Into Atomic Nuclei Under H(3) Bombardment," "Adsorption Analysis of High-Molecular Substances," "Radioactive Selenium 73 and 75," "The Effects of Pile Bombardment on Uncured Elastomers," "Mesotrons in the Stratosphere," "The Magnetic Susceptibility of Uranium Oxalate," "Dynamic Mechanical Properties of Rubber-like Materials," "Low-Temperature Transformations in Lithium and Some of Its Alloys," "Theoretical Analysis of the Effect of Imperfections in Diffraction-Gratings," and "Absorption of Microwaves by Hydrogen Atoms." The American Physical Society will also participate jointly with the American Association of Physics Teachers in the presentation of a symposium on "Microwaves and Their Uses." All meetings of the physical science societies will be held at The University of Chicago.

The American Association of Physics Teachers and the *American Physical Society* will also meet jointly for a dinner session at the International House, The University of Chicago, 7:00 P.M., Tuesday, December 30. Paul E. Klopsteg will present the evening address, "Bows and Arrows." The general business session of the Society will be held in Kent Theater on Tuesday morning, December 30. At this session Marsh M. White will discuss "The Utilization of Physicists by the Army of World War II." In addition to a program of contributed papers to be presented on Monday afternoon and the joint session with the American Physical Society, the American Association of Physics Teachers will meet jointly with the AAAS Section on Physics at the Oriental Institute, Tuesday afternoon, December 30.

The American Meteorological Society plans to meet on Monday morning and afternoon and Tuesday morning, December 29 and 30. In addition to contributed papers, the Monday afternoon session will be a symposium on "Experimental Meteorology and Instrumentation." All meetings will be held in Room 122, Social Science Research Building, 59th Street near University Avenue, The University of Chicago.

Sigma Pi Sigma will hold its annual luncheon in conjunction with the meeting of the American Physical Society at 12:30 P.M., Tuesday, December 30, in the Quadrangle Club of The University of Chicago. Advance reservations may be made by writing to M. W. White, Executive Secretary of the Sigma Pi Sigma, Physics Department, Pennsylvania State College, State College, Pennsylvania. During the meetings tickets may be obtained at the registration desk in the Palmer House Hotel until 10:00 A.M., Tuesday morning.

Section C (*Chemistry*) will meet jointly with the American Chemical Society, Chicago Section, on Friday, December 26. Special symposia sponsored by the Section will be held on Friday afternoon, and Saturday and Sunday mornings and afternoons. These include "Industrial Processes," "Mechanisms of Hydrocarbon Reactions," and "Photosynthesis." The symposium on "Photosynthesis" is divided into three subheadings: "Mechanisms in Photosynthesis," "Isotopic Tracers in Photosynthesis," and "Quantum Efficiencies in Photosynthesis." Titles of the program of Section C selected at random include: "Attempts to Synthesize Large Conjugated Ring Systems," "Some Recent Developments in Antibiotics," "Free Radical Additions to Unsaturated Compounds," "The Mechanism of Isomerization of Saturated Hydrocarbons," "The Addition of Aromatic Compounds to the Carbon-Carbon Double Bond," "Chlorophyll Studies," "Chlorophyll Formation and Related Processes," "Theories of Photosynthesis," "Problems in Photosynthesis." The Section will hold a luncheon each day of the meeting period and jointly with the American Chemical Society, Chicago Section, on Friday.

The American Chemical Society, Chicago Section, will hold its annual meeting jointly with the AAAS Section on Chemistry (C) on Friday, December 26. Sessions will be held on Agricultural and Food Chemistry, Chemical Education, Industrial and Engineering Chemistry, Organic Chemistry, Petroleum Chemistry, Radiochemistry, Biological and Pharmaceutical Chemistry, Physical Chemistry, and Inorganic and Analytical Chemistry. Titles from among these sessions include: "A New Method for Determining Storage Changes and Quality of Foods," "Science in Liberal Education," "Destructive Alkylation of Hydrocarbons," "Polymerization of Olefins in Cracked Gases," "A New Radioactive Series," "Progress in Histamine and Antihistamine Research," "A New Method for the Titration of Basic Groups of Amino Acids and Proteins," and "Statistical Analysis of Physical Constant Data of Hydrocarbons." All meetings will be held in the Sherman Hotel.

Section D (Astronomy) will meet on Friday and Saturday, December 26 and 27, at the Sherman Hotel. The Friday afternoon session includes such titles as "On the Origin of Meteorites" and "A Theory of the Origin of Cosmic Rays." On Saturday morning G. Van Biesbroeck will present an address as retiring vice-president of the AAAS and chairman of Section D, entitled "The Einstein Shift in the Sun's Gravitational Field." A symposium on "The Origin of the Earth" will be held on Saturday afternoon, F. R. Moulton, presiding. The titles include "Facts of Geology and the Origin of the Earth," "Structure of Earth's Interior and the Origin of the Earth," "Elements in Meteorites and the Earth's Origin," "Theories of the Origin of the Earth," and "A New Theory of the Origin of the Earth." This symposium will be held jointly with the AAAS Section on Geology and Geography.

Section E (Geology and Geography) will meet on Friday and Saturday, December 26 and 27. The Friday sessions will be devoted to a symposium on "Problems of Mississippian Stratigraphy and Correlation," and the Saturday sessions to "Methods of Ground-Water Investigation." A joint session will also be held on Saturday afternoon with the Section on Astronomy (see above). On Friday afternoon John L. Rich will present an address as retiring vice-president of the AAAS and chairman of Section E, on "Goals and Trends in Geological and Geographical Research." Among the papers to be presented at the sessions are "Status of Mississippian Stratigraphy in the Appalachian Region," "Problems of Mississippian Stratigraphy in Southwestern United States," "Paleontological Comparison of American and European Mississippian Sections," "Ground-Water Exploration by the Electrical Resistivity Method," and "The Use of Soil Maps in Ground-Water Investigations in Indiana."

Section F (Zoological Sciences) will hold no formal sessions of its own aside from a brief business meeting at 12:00 noon, Tuesday, December 30, in the French Room, Blackstone Hotel, and the retiring address of the vice-president of the AAAS and chairman of Section F, Franz Schrader. Dr. Schrader will speak on "Three Quarter-Centuries of Cytology," following the Zoologists' Dinner Tuesday evening.

The American Association of Economic Entomologists will meet Saturday through Tuesday, December 27–30, at the Congress Hotel. The opening joint session with the Entomological Society of America on Saturday afternoon will be on training teachers in entomology, methods of teaching entomology, and the professional placement of graduate students in entomology. Running concurrently with this session will be the AAEE Section of Insecticides, including the chemistry, bioassay, formulation, and manufacture of insecticides. On Saturday evening the Section of Extension will meet concurrently with a session on Insecticides and Equipment. On Sunday morning Ernest N. Cory, president of the AAEE, will address a joint session with the Entomological Society of America on "Totalitarian Insects." Immediately following the address, a meeting will be held on "Insects Affecting Livestock and Man." In the afternoon this meeting will be continued concurrently with meetings of the Section of Plant Pest Control and Quarantine, Section of Apiculture, and a session on "Insects Affecting Miscellaneous Crops." The Entomologists' Banquet will be held in the Casino Room of the Congress Hotel on Sunday evening, December 28. On Monday morning Stephen S. Easter, of the United Nations Food and Agriculture Organization, will present a general address which will be followed by a symposium on "The Toxicity of Insecticides to Plants, and Animals Other Than Man." Three concurrent sessions will be held Monday afternoon: "Administrative Problems of Airplane Application of Insecticides," "Insects Affecting Fruit Crops," and "Insects Affecting Cereal and Forage Crops." Alfred E. Emerson, of The University of Chicago, will address a joint session with the Entomological Society of America on Monday evening, December 29. The title of Dr. Emerson's address is "The Zoogeography of the Termite." The final sessions on Tuesday afternoon include a symposium on the "Effects of Insecticides on Biological Control" and contributed papers on "Insects Affecting Truck and Vegetable Crops."

The American Society of Parasitologists will hold its 22nd annual meeting on Monday and Tuesday, December 29 and 30, at the Congress Hotel. Monday's sessions will be devoted to contributed papers. The principal paper of the Tuesday morning session will be an address by Harley J. Van Cleave, president of the American Society of Parasitologists. Dr. Van Cleave will speak on "Expanding Horizons in the Recognition of a Phylum." The Parasitologists' Luncheon will be held at

12:30 P.M. in the Stevens Building Restaurant, 17 N. State Street. The annual business session will be held in the Francis I room of the Congress Hotel at 1:30 P.M., followed by a demonstration program commencing at 3:00 P.M. General papers on parasitology will form the bulk of the morning's program on Wednesday, the concluding session in the afternoon being a symposium on "Exoerythrocytic Forms of Malarial Parasites."

The American Society of Zoologists will meet Monday through Wednesday, December 29–31, at the Blackstone Hotel. Concurrent sessions on Monday morning include "Cytology and Cellular Physiology," "Embryology," "Endocrinology," "General Physiology," and a joint symposium with the American Society of Naturalists, *et al.*, on the "Genetics of Microorganisms." The Monday afternoon session will be held jointly with the Genetics Society of America for the presentation of a symposium on "Plasmagenes, Genes, and Characters in *Paramecium aurelia.*" Four concurrent sessions have been planned for Tuesday morning: "Cytology," "Embryology," "Endocrinology," and "General and Cellular Physiology." The annual business meetings of Section F and the Society will be held at 12:00 noon in the French Room of the Blackstone Hotel. A general demonstration program will be held in Room 24, Hull Zoological Laboratory, The University of Chicago, on Tuesday afternoon, and motion pictures will be shown in Room 14. At 3:00 P.M. the motion-picture program will be repeated in Room 106 of the Hull Botanical Laboratory. The Zoologists' Dinner will be held in the Crystal Ballroom of the Blackstone Hotel at 7:00 P.M. on Tuesday, December 30. Franz Schrader, chairman of Section F, AAAS, will speak on "Three Quarter-Centuries of Cytology." On Wednesday morning there will be concurrent sessions on "Cellular Physiology and Protozoology," "Embryology and General Morphology," "Evolution and Ecology," and "General Physiology." The closing session on Wednesday afternoon will be a joint symposium with the Genetics Society of America on "Methods for the Genetic Improvement of Farm Animals."

The Entomological Society of America will hold its 42nd annual meeting from Saturday through Monday, December 27–29, at the Congress Hotel. In addition to the joint sessions enumerated under the American Association of Economic Entomologists, there will be an Executive Committee meeting on Saturday evening, sessions of contributed papers Sunday morning and afternoon, a session on "Taxonomy and Physiology" Monday afternoon, a joint session with the Ecological Society of America on Tuesday morning, and a Business Session on Tuesday afternoon. The annual Entomologists' Banquet will be in the Casino Room, Congress Hotel, Sunday evening, December 28.

The Herpetologists League will hold one joint session with the Ecological Society of America on Monday at 2:00 P.M. in the Casino Foyer of the Congress Hotel.

The Society of Systematic Zoologists has scheduled a preliminary meeting in Parlor D of the Congress Hotel on Monday morning, December 29, to consider the organization of a society of animal taxonomists. All individuals interested in the proposed society are cordially invited to attend. On Monday afternoon Dr. Francis Hemming, secretary of the International Commission on Zoological Nomenclature, will address a meeting to be held at 3:30 in the Upper Tower Room of the Stevens Hotel. Dr. Hemming's visit to this country is under the auspices of the Smithsonian Institution, Washington, D. C.

The American Microscopical Society will hold a luncheon for its Executive Committee at 1:00 P.M. on Monday, December 29, in the Pompeian Room of the Congress Hotel. On Wednesday at 4:00 P.M. the 64th annual meeting will be held in the Casino Foyer of the Congress Hotel.

The American Society of Naturalists will meet on Monday, December 29, and Wednesday, December 31, in the Congress Hotel. The program of the 63rd annual meeting includes a symposium on "The Genetics of Microorganisms," to be held on Monday morning in the Stevens Hotel, H. A. Rodenhiser presiding. The papers include "Mutations in Viruses," by W. M. Stanley and C. A. Knight; "Bacteriophage Mutations and Interactions Between Bacteriophage Particles Inside the Host Cell," by S. E. Luria; "Spontaneous and Induced Mutations in Bacteria," by M. Demerec; "Chromosome Behavior in *Neurospora* During Ascosporogenesis," by B. McClintock and J. R. Singleton; "Genetics of the Smut and Rust Fungi," by E. C. Stakman; and "Inheritance of Pathogenicity in *Venturia inaequalis,*" by G. W. Keitt. Participating in this session are the American Phytopathological Society, American Society of Zoologists, Botanical Society of America, Ecological Society of America, National Research Council Committee on the Genetics of Microorganisms, and Society for the Study of Evolution.

The Biologists' Smoker, sponsored by the American Society of Naturalists, will be held in the Chicago Natural History Museum, Monday, December 29, at 9:00 P.M. All biologists are cordially invited to attend. Refreshments will be available. Since city bus service to the Museum is suspended at 6:30 o'clock daily, special bus transportation will be provided for the smoker. At 10-minute intervals between the hours of 9:00 P.M. and 12:00 P.M. buses will leave for the Chicago Natural History Museum (Field Museum) from in front of the Stevens Hotel, and also for return from the Museum to the Stevens Hotel. Bus tickets may be purchased at the ticket booth located in the registration area of the Stevens Hotel. On Wednesday morning the Naturalists will meet jointly with the Ecological Society of America and the Society for the Study of Evolution, for a round-table discussion on "Bird and Mammal Population Mechanisms." The Florentine Ballroom, Congress Hotel, will be the site of the Naturalists' Dinner on Wednesday at 6:00 P.M.

Beta Beta Beta Biological Fraternity will hold a luncheon session in the North Pompeian Room, Congress Hotel, at 1:00 P. M. on Monday, December 29.

The Biometric Society (Eastern North American Region) will meet jointly with the Biometrics Section of the American Statistical Association on Friday and Saturday, December 26 and 27, at the Stevens Hotel.

The Biometrics Section of the American Statistical Association will present a joint symposium with the Biometric Society on "Mathematical Biology." Representative papers include "Recent Advances in Mathematical Biophysics," "Mathematics in Radiobiology," "Mathematical Theory of Perception," "The Kinetics of Blood Coagulation," and "The Physical Aspect of Organic Evolution."

The Ecological Society of America will hold its 32nd annual meeting from Monday to Wednesday, December 29–31, at the Congress Hotel. Three concurrent sessions on Monday morning will include "Plant Ecology," "Animal Ecology," and a joint symposium with the American Society of Naturalists, *et al.*, on "The Genetics of Microorganisms." The Monday afternoon program includes joint sessions with the Herpetologists League, the Botanical Society of America, and the Committee for the Study of Animal Societies. Tuesday morning's concurrent sessions include "Plant Ecology" and a joint meeting with the Entomological Society of America; the afternoon sessions include a joint meeting with the Society for the Study of Evolution, "Applied Ecology," and the annual business meeting of the Society at 4:00 P.M. in the English-Walnut Room of the Congress Hotel. The dinner of the Ecological Society of America will be held in the Florentine Ballroom of the Congress Hotel on Tuesday at 7:30 P.M. The Wednesday morning sessions include joint sessions with the American Society of Naturalists and Society for the Study of Evolution ("Bird and Mammal Population Mechanisms"), the Limnological Society of America (symposium on "Bottom Sediments"), and the Natural Resources Council of America (symposium on "Conservation and a Stable Society"). The final concurrent sessions on Wednesday afternoon include "Animal Ecology," symposium on "The Biota of Mexico and Guatemala," the business meeting of the Grassland Research Foundation, and the business meeting of the Ecologists' Union.

The Genetics Society of America will meet Monday through Wednesday, December 29–31, at the Stevens Hotel. The opening session on Monday morning will be a joint symposium with the American Society of Naturalists, *et al.*, on the "Genetics of Microorganisms." A joint symposium with the American Society of Zoologists will be held in the afternoon on "The Plasmagenes, Genes, and Characters in *Paramecium aurelia*." On Tuesday the Society will meet on the campus of The University of Chicago for sessions of short papers in Mandel Hall, morning and afternoon, and a demonstration program in Room 13 of the Zoology Building. Concurrently with the morning sessions at the University, the Genetics Society is sponsoring a joint symposium on "Natural Hybridization" with the Society for the Study of Evolution, in the Congress Hotel. The annual luncheon and business meeting will be held in Hutchinson Commons, The University of Chicago, at 12:00 noon, Tuesday. Sessions on the last day of the three-day meeting period will be held in the Stevens Hotel. The morning session will consist of short papers and the afternoon session will be a symposium on "Methods for the Genetic Improvement of Farm Animals," held jointly with the American Society of Zoologists.

The Limnological Society of America will meet Monday through Wednesday, December 29–31. Monday's sessions of contributed papers will be held at the Chicago Natural History Museum. On Tuesday the Society will meet jointly with the AAAS Section on Engineering for the presentation of a symposium on "Limnological Aspects of Water Supply and Waste Disposal," at the Stevens Hotel. The sessions on Wednesday will be held in the West Ballroom of the Stevens Hotel, the morning program being a symposium on "Bottom Sediments," held jointly with the Ecological Society of America, and the afternoon being devoted to general papers.

The National Association of Biology Teachers will meet Sunday through Tuesday, December 28–30, at the Sherman Hotel. From 9:00 A.M. to 3:00 P.M., Sunday, the Association will participate with the American Nature Study Society in a joint field trip to Dune State Park. The two societies will reconvene Monday afternoon in the Sherman Hotel for a panel discussion on "What Is Resource-Use Education and How Does It Fit Into Our School Program?" On Tuesday a joint symposium on "Teaching Behavior in High School Biology" with the American Nature Study Society will be held in the morning and afternoon, followed by the Biology Teachers' Dinner in the evening. Dr. A. L. Windsor will address the dinner session on "The Selection and Maintenance of Science Teachers."

The National Research Council Committee on the Genetics of Microorganisms is sponsoring with the American Society of Naturalists, *et al.*, a symposium on "The Genetics of Microorganisms," Monday morning, December 29, in the Stevens Hotel. Members of the Committee include H. A. Rodenhiser, chairman, M. Demerec, H. H. McKinney, A. J. Riker, E. C. Stakman, and W. H. Taliaferro.

The Society for the Study of Evolution will meet Monday through Wednesday, December 29–31, at the Congress Hotel. In addition to papers on zoology Monday afternoon and on botany Wednesday afternoon, the Society will jointly sponsor 5 symposia: "Genetics of Microorganisms," Monday morning; "Natural Hybridization" and "Evolution and Classification of Angiosperms," Tuesday morning; "Evolution and Classification of Gymnosperms," Tuesday afternoon; and "Bird and Mammal Population Mechanisms," Wednesday morning. J. T. Patterson, L. R. Dice, H. N. Andrews, Thomas Park, Aldo Leopold, and Howard K. Gloyd will serve as presiding officers.

The American Society of Professional Biologists will meet on Sunday afternoon in Private Dining Room 4, Stevens Hotel, to discuss objectives and future plans of the Society. All biologists are cordially invited to attend.

Section G (Botanical Sciences) will hold a joint session with all plant science societies on Saturday afternoon, December 27, in the North Ballroom, Stevens Hotel. Walter F. Loehwing, as chairman of the Section on Botany, will present the AAAS vice-presidential address, entitled "The Developmental Physiology of Seed Plants." Also scheduled on the afternoon program are: "Correlations Between Growth, Metabolism, and Salt Accumulation," by F. C. Steward; "Nutrient Requirements of Fungi," by W. J. Robbins; and "Correlation at the Community Level," by Paul B. Sears.

The American Fern Society, in addition to participating in the joint session with Section G, will hold a single session on Saturday morning, December 27, in Room 20, Stevens Hotel. R. M. Tryon, Jr., will present a paper on "Ferns of the Sleeping Giant, Thunder Bay, Ontario," followed by a round-table discussion on "Recent Discoveries; Range Extensions," with a display of fern specimens.

The American Phytopathological Society will meet Saturday through Tuesday, December 27–30, at the Stevens Hotel. Business meetings will be held on Saturday. The general sessions will commence Sunday afternoon with concurrent programs on "Diseases of Corn and Small Grains," and "Diseases of Fruits and Ornamentals." The Monday morning meetings include a "Fungicide Colloquium" and contributed papers on "Diseases of Field Crops" and "Virus Diseases." The phytopathologists are also cosponsoring a meeting with the American Society of Naturalists, *et al.*, on Monday morning on the "Genetics of Microorganisms." The afternoon sessions are on "Breeding and Disease Resistance," "Market Diseases of Fruits and Vegetables," "Extension Workers Conference," and "Plant Disease Survey Conference." The Chicago Bar Association will be the site of the Phytopathologists' Dinner, Monday evening. Two concurrent sessions will be held on Tuesday morning, "Antibiotics and Bacterial Diseases" and a joint meeting with the Potato Association of America. "Virus Diseases of Vegetables" and "Vegetable Diseases" will constitute the afternoon programs. The concluding sessions on Tuesday evening will include miscellaneous papers and a round-table discussion of National Security.

The American Society of Plant Physiologists will meet Saturday through Tuesday, December 27–30, at the Stevens Hotel. All sessions will be joint with the Physiological Section of the Botanical Society of America. Representative papers include "Uraform, Phosphate Rock, and Expanded Vermiculite as Nutrient Sources in Soilless Culture Experiments," "Preliminary Studies on the Mechanism of 2,4-Dichlorophenoxyacetic Acid in Higher Plants," "The Healing Action of Extracts of *Aloe vera* Leaf on Abrasions of the Human Skin," "Spectral Properties of Protochlorophyll Isolated by Absorption," "Phytotoxic Reactions of Blood Sera as an Aid to Medical Diagnosis and Therapy," "Photoperiodic Responses in Corn," and "Some Common Alcohols as Carbon Sources for Plant Tissue Cultures." Special symposia include a Sunday afternoon session on "Radioactive Isotopes in Plant Physiological Research," and a Monday afternoon session on "Dormancy." The Plant Physiologists' Dinner will be held on Saturday evening in the Casino Room of the Congress Hotel. Following the Charles Reid Barnes Life Membership Award, Burton E. Livingston will present the Stephen Hales Lecture, and B. M. Duggar will speak on "Physiology and Prevailing Influences."

The American Society of Plant Taxonomists will meet jointly with the Systematic Section of the Botanical Society of America from Saturday through Tuesday, December 27–30. The Plant Taxonomists' Dinner will be held in the South Ballroom of the Stevens Hotel on Monday evening, December 29.

The Botanical Society of America will hold its 42nd annual meeting Saturday through Tuesday, December 27–30, at the Stevens Hotel. In addition to a business meeting and meeting of the General Section on Saturday morning, three sessions will be held by other sections. The Microbiological Section will hold a symposium on "Nutrition and Metabolism of Microorganisms," the Physiological Section will meet jointly with the American Society of Plant Physiologists, and the Systematic Section with the American Society of Plant Taxonomists. On Saturday afternoon all the plant science societies will meet with the AAAS Section on Botany, W. G. Loehwing presiding. The Botanical Teaching Section will meet Sunday morning and afternoon, the latter session being a symposium on "General Botany Texts." Tickets to the Botanists' Dinner, to be held Sunday evening on the 8th floor of the Stevens Building Restaurant, 17 North State Street, may be purchased at the Ticket Booth in the AAAS Registration Area, Stevens Hotel. On Monday morning concurrent sessions will be held by the General Section, Microbiology Section (jointly with other biological societies for a symposium on the "Genetics of Microorganisms"), Physiological Section, Paleobotanical Section, and Systematic Section (jointly with the American Society of Plant Taxonomists for a symposium on "Biological Nomenclature"). With the exception of the Paleobotanists, these same sections will meet in the afternoon: Microbiological Section jointly with the

Mycological Society of America; Physiological Section jointly with the American Society of Plant Physiologists and the American Society for Horticultural Science (symposium on "Dormancy"); Systematic Section jointly with the American Society of Plant Taxonomists. The Microbiological, Physiological, and General Sections will reconvene Tuesday morning and afternoon. The Paleobotanical Section will meet jointly in the morning and afternoon with the Society for the Study of Evolution for the presentation of symposia on "The Evolution and Classification of Angiosperms and Gymnosperms." The final meeting of the Systematic Section will be held Tuesday morning.

The Mycological Society of America will meet Saturday through Tuesday, December 27-30, at the Stevens Hotel. With the the exception of sessions of contributed papers on Saturday morning and Tuesday morning, all meetings of the mycologists will be joint with the Microbiological Section of the Botanical Society of America.

The Phycological Society of the Americas, in addition to a business meeting on Sunday morning, will hold a meeting of general papers in the Stevens Hotel on Wednesday morning, December 31. Among the papers are: "Marine Algae of the Marshall Islands," "The Case Against a Separate Division or Phylum for the Characeae," and "A Review of Phycological Investigations in Southeastern United States."

The Sullivant Moss Society plans a breakfast in the Standard Restaurant, Standard Oil Building, 910 S. Michigan Avenue, Monday morning, December 29. At 9:00 A.M. the group will convene in the Stevens Hotel for a business session followed by a program of short papers. The afternoon session will be devoted to a symposium on "Generic Concepts of the Bryophyta."

Section H (*Anthropology*) will meet on Friday and Saturday, December 26-27, at the Sherman Hotel. Papers on General Anthropology will be presented Friday afternoon. In the evening Wilson D. Wallis will present a dinner address as vice-president of the AAAS and chairman of the Section on Anthropology. His address, "Presuppositions in Anthropological Interpretations," will be followed by a motion picture. On Saturday the morning session will be on "Linguistics and Culture" and the afternoon program a joint session with the Society for Research in Child Development on "The Socialization of the Child." Representative papers include "Some California Traits and Their Eastern Parallels," "Are Basic Needs Ultimate?," "Linguistic Descriptions as Axiomatic Systems," and "Sociological Aspects of Some Features of English Pronunciation."

Section I (*Psychology*) will join with the Sections on Zoological Sciences, Social and Economic Sciences, History and Philosophy of Science, and the American Philosophical Association in the presentation of a symposium on "Problems of Concept Formation in Psychology," Saturday afternoon, December 27. The Monday morning session will be on "Physiological Psychology," and the afternoon session on "Learning." "Personnel and Educational Psychology" will be the subject of the Tuesday morning session. Selected papers include "On the Control of Blood Pressure in Man," "The Effects of Different Types of Preliminary Activities on Subsequent Learning of Paired-Associate Material," "Criteria of Learning in Educational Research" (address of AAAS vice-president and chairman of the Section on Education, W. A. Brownell), "The Work of Our Hands" (address of AAAS vice-president and chairman of the Section on Psychology, Edna Heidbreder), "The New Army Rating System—Its Development and Validation," and "American Intelligence."

The Society for Research in Child Development will meet on Saturday, December 27, at the Palmer House. The morning session is on "Projective Techniques in the Study of Children" and "Biological Factors in Personality Formation." "Socialization of the Child" will be discussed in the afternoon. Titles selected at random include "Children's Personality and Their Painting," "Doll Play," "Biology and Personality in Young Children," "Socialization and the Parent-Child Relationships," and "The Fate of Basic Drives in Various Cultures."

Section K (*Social and Economic Sciences*) will meet Saturday through Wednesday, December 27-31, at the Sherman Hotel. The opening session on Saturday morning will be a symposium on "War and Postwar Population and Labor Force Developments." In the afternoon there will be a joint symposium with the Section on the History and Philosophy of Science on "Are Human Social Problems in a Different Category from the Integrations of Biology?" Section K will join with the American Economic Association for a dinner session on Sunday evening. A joint symposium with the National Association of Science Writers on "The Problem of Making Scientific Findings Comprehensible to the Public" will be held on Monday afternoon. On Tuesday afternoon "Production Functions and the Theory of the Firm" will be discussed jointly with the Econometric Society in Room 507, Wieboldt Hall, on the Chicago Campus of Northwestern University. The closing session on Wednesday morning will be a symposium on "Some Determinants of National Productivity," held jointly with the American Economic Association, Academy of World Economics, and the AAAS Section on Engineering. Among the papers are "Labor Force Developments," "The Responsibility of the Science Writer," "Factors Affecting International Differences in Production," and "Relation of Energy Output to Production in the United States."

The Academy of World Economics will participate in a joint symposium with other social science societies on "Some Determinants of National Productivity," Wednesday morning, December 31.

The Econometric Society will meet Saturday, Monday, and Tuesday, December 27, 29, and 30. In addition to contributed papers, the Society has organized several symposia: "Relationships Derived From Aggregate Data," Saturday afternoon; "Savings Investment and Wage Rates," Monday afternoon; "Inventories in the Business Cycle," Tuesday morning; and "Production Functions and the Theory of the Firm," Tuesday afternoon.

Pi Gamma Mu, National Social Science Honor Society will hold a luncheon in honor of the officers and speakers appearing on the program of the AAAS Section on Social and Economic Sciences, Saturday noon, in Rooms 109 and 110, Sherman Hotel.

Section L (*History and Philosophy of Science*) will meet Saturday and Sunday, December 27 and 28, at the Sherman Hotel. Each session will be a symposium held jointly with the American Philosophical Association. On Saturday the morning session will be on "Foundations of Modern Physics," followed in the afternoon by a session on "Problems of Concept Formation in Psychology," held jointly with the AAAS Sections on Zoological Sciences, Psychology, and Social and Economic Sciences. The concluding session on Sunday afternoon, to be held jointly with the AAAS Section on Social and Economic Sciences, will be on "Are Human Social Problems in a Different Category From Integrations of Biology?" Representative papers include "The Formation of Concept in Personality and Dynamic Psychology," "The Problem of Anxiety: Some Conceptual Difficulties," "The Place of Logic in the Advance of Science," "Cosmology and Logic," "Principles of Impotence in Modern Physics," "Biological Principles in Sociology," "Human Social Problems as a Type of Disintegration in a Biological Integration," and "The Relation Between Biological Cultural Factors in Social Problems" (Section L vice-presidential address by F. S. C. Northrop).

The American Philosophical Association will hold all of its sessions jointly with the AAAS Section on the History and Philosophy of Science.

The Philosophy of Science Association will meet on Saturday and Sunday, December 27 and 28, at the Palmer House, for the presentation of a syposium on "What Does the Natural Scientist Need From the Social Scientist?"

Section M (*Engineering*) will meet Tuesday and Wednesday, December 30–31, at the Stevens Hotel. The sessions on Tuesday will be devoted to a symposium on "Limnological Aspects of Water Supply and Waste Disposal," held jointly with the Limnological Society of America. On Wednesday morning there will be a joint symposium on "Some Determinants of National Productivity" with the American Economic Association, Academy of World Economics, and the Section on Social and Economic Sciences. Representative papers include "Some Epidemiological and Biological Problems in Water-Borne Amoebiasis," "Biotic Responses to Stream Pollution During Artificial Stream Reaeration," "Plankton as Related to Nuisance Conditions in Surface Water," "Prevention of Algal Nuisance by the Removal of Nitrogen and Phosphorous From Sewage Plant Effluents," and "The Algologist's Part in the Solution of City and Industrial Water Supply Problems."

Section N, Medical Sciences (*Subsection on Medicine*) will meet Monday through Tuesday afternoon, December 29–30, at the Sherman Hotel, for the presentation of a symposium on Antibiotics. The subdivisions of the symposium are "Production, Chemistry, and Lesser Known Substances," Monday morning; "Pharmacology and Action of Antibiotics," Monday afternoon; "Development of Resistance to Antibiotics," Tuesday morning; and "Clinical Applications," Tuesday afternoon. On Tuesday afternoon E. V. Cowdry, as vice-president of the AAAS and chairman of the Section on Medical Sciences, will deliver an address entitled "Symbiosis and Antibiosis."

Section N, Medical Sciences (*Subsection on Dentistry*) will hold a symposium on "Dental Caries" on Sunday, December 28, at the Sherman Hotel. The morning program will be on "Bacteriological and Biochemical Aspects," the afternoon program on "Nutrition and Substrata," and, following the Dentists' Dinner, papers will be presented on "Prevention and Control, Public Health Aspects." Representative papers will include "Is Caries of Enamel a Process of Decalcification Resulting From Bacterial Action?," "Nutritionist's View of the Caries Problem," "What Is the Relative Importance of the Polysaccharides, Disaccharides, and Monosaccharides in Caries Production?," and "Roles of Dental Clinics in Caries Control."

Section N, Medical Sciences (*Subsection on Pharmacy*) will hold an all-day session of general papers on Saturday, December 27, at the Sherman Hotel. Representative papers include "Methods for the Evaluation of Compounds With Curare-like Action," "Antagonism of Histamine and Epinephrine With Synthetic Chemicals," and "Industrial Pharmacy: Opportunities and Training."

The American Dietetic Association will meet on Monday and Tuesday, December 29–30, at the Palmer House. General papers include "The Nitrogen Metabolism of Women," "Food and Its Emotional Significance," and "Problems of Feeding the School Age Child."

Section O (*Agriculture*) will hold a joint symposium on "Breeding and Improvement of Horticultural Crops" with the American Society for Horticultural Science on Tuesday afternoon, December 30. W. A. Alderman, vice-president of the AAAS and chairman of the Section on Agriculture, will speak on "Fruit Breeding: Past, Present, and Future." Other papers include "Genetics as a Tool of the Plant Breeder" and "Breeding of Ornamental Plants."

The American Society for Horticultural Science will hold its 44th annual meeting Monday through Wednesday, December 29–31. Concurrent sessions on Monday include "Pomology—Nutrition," "Pomology—Breeding and Propagation," "Vegetables—Tomatoes," and "Floriculture and Ornamental Horticulture—Herbicides, Growth Regulators, and Nutrition." A joint symposium on Dormancy will be held on Monday afternoon with the American Society of Plant Physiologists and the Physiological Section of the Botanical Society of America. Monday evening round-table sessions include "Breeding Methods for Horticultural Crops," "Mineral and Nitrogen Deficiency Diagnosis," "Discussion on Education," and "Discussion on Extension in Horticulture." Four concurrent sessions have been planned for Tuesday morning: "Pomology—Growth Regulators and Chemical Flower Thinners," "Pomology—Small Fruits and Grapes," "Vegetables—Herbicides and Growth Regulators," and "Floriculture and Ornamental Horticulture—General." The Tuesday afternoon sessions include a joint symposium with the AAAS Section on Agriculture on the "Breeding and Improvement of Horticulture Crops." Running concurrently will be sessions on "Fruit Physiology and Storage" and "Vegetables—General." At the annual banquet, on Tuesday evening in the Red Lacquer Room of the Palmer House, H. B. Tukey will present the presidential address of the Society on "Horticulture in Science and Society." The concluding sessions on Wednesday morning will cover "Pomology—General," "Vegetables—Breeding and Nutrition," "Vegetables—Potatoes and Sweet Potatoes," and "Floriculture and Ornamental Horticulture." A business meeting of the Society will be held on Wednesday afternoon for reports of committees and election of officers.

The Potato Association of America will hold its 21st annual meeting Sunday through Wednesday, December 28–31, at the Palmer House. The opening session on Sunday afternoon will be a round-table discussion on "Seed Certification." On Monday a session on general papers has been planned for the morning and a "Smoker and General Round-Table Discussion" scheduled for the evening in Private Dining Room 18 of the Palmer House. On Tuesday morning the society will meet jointly with the American Phytopathological Society at the Stevens Hotel, followed by an afternoon session of general papers in the Palmer House. The concluding session on Wednesday morning will be joint with the American Society for Horticultural Science. Representative papers include "Progress of Virus and Bacterial Disease Investigations," "Insect Investigations in 1947," "Chemical Control of Weeds in Potatoes," and "Effects of Spraying a Sprout Inhibitor on Potato Plants in the Field."

Section Q (Education) will meet Monday and Tuesday, December 29–30, at the Sherman Hotel. A symposium on Science and Social Philosophy will be held on Monday morning, and in the evening the chairmen of the AAAS Sections on Psychology and Education will present addresses before a joint session with the Section on Psychology. W. A. Brownell will speak on "Criteria of Learning in Educational Research," and Edna Heidbreder's address will be on "The Work of Our Hands." On Tuesday morning Guy T. Buswell will preside at a symposium on "Group and Individual Research," followed by an afternoon session of general papers. The business meeting of the Section will be held immediately following the last paper of this session. Representative papers on the program of the Section on Education include "The Scientific Point of View in Education," "The Social Responsibilities of Modern Science," "Education and the Scientific Outlook in Philosophy," "The Role of Individual Research in a World of Large-Scale Organization," and "International Comparisons in Child Development in Spelling."

AAAS Cooperative Committee on Science Teaching will meet Saturday through Tuesday, December 27–30, at the Sherman Hotel. The opening session will be a business meeting on Saturday evening. Sunday evening the Committee will hold a dinner session followed by a forum on "The Effectiveness of Science Teaching." The remaining sessions on Monday and Tuesday will be held jointly with the National Science Teachers Association. For additional information, consult the AAAS Special Sessions listed in the forepart of this Preview.

The National Science Teachers Association will meet Friday through Tuesday, December 26–30, at the Sherman Hotel. The Junior Scientists' Assembly, a program of papers, talks, and discussions by members and recent members of Junior Academies of Science, Science Clubs of America, and School Science Clubs, will be held on Saturday afternoon. On Sunday afternoon there will be a session on "The Relations of Science Teaching With Industry." Three concurrent sessions, joint with the AAAS Cooperative Committee on Science Teaching, have been scheduled for Monday morning. The program of the annual luncheon of the National Science Teachers Association, to be held on Monday at noon, will include a tribute to the life and work of Otis W. Caldwell. Tickets to the luncheon may be obtained at the registration desk in the Sherman Hotel. Meetings of the Board of Directors will be held on Monday and Tuesday evenings. Rooms 103 and 104 will serve as the convention headquarters for the National Science Teachers Association throughout the meeting period.

Pi Lambda Theta has arranged a Tour of Modern Art and a Tea, for all scientists, at the Art Institute of Chicago on Sunday afternoon, December 28. The Tour of the Birch Bartlett Gallery of Modern Art will commence at 2:30 P.M. Tea will be served from 3:30 to 5:00 P.M. A nominal admission fee of $1.00 will be charged. Tickets may be obtained at the ticket booth in the registration area in the Stevens Hotel.

The American Nature Study Society will meet Friday through Tuesday, December 27–30, at the Sherman Hotel. In addition to sessions of general papers, the Society will hold a panel discussion on "What Is Resource-Use Education and How Does It Fit Into Our School Program?" on Monday afternoon, and a symposium on "Teaching Behavior in High School Biology" on Tuesday morning and afternoon, jointly with the National Association of Biology Teachers. On Sunday morning a joint Field Trip has been planned with the NABT to Dune State Park, with E. W. Teale and E. L. Palmer as leaders. The annual banquet will be held on Saturday evening in the Crystal Room of the Sherman Hotel. E. W. Teale will speak on "Adventures in an Insect Garden."

The National Association of Science Writers, in addition to a business meeting held immediately following the AAAS-George Westinghouse Science Writing Awards Ceremony on Saturday evening, will hold a joint symposium on Monday afternoon entitled "The Problem of Making Scientific Findings Comprehensible to the Public," with the AAAS Section on Social and Economic Sciences.

Honor Society of Phi Kappa Phi will hold a business session on Monday afternoon, December 29, and a breakfast session on Tuesday morning. There will be a second business session immediately following the breakfast.

The Research Council on Problems of Alcohol will meet for a morning and afternoon session on Monday, December 29, at the Sherman Hotel. Representative papers include "Unexplored Frontiers in Scientific Research on the Problem Drinker," "The Medical Approach to Problem Drinking," "Fundamental Research Plan to Problem Drinking," and "Medicolegal Problems and the Problem Drinker."

Sigma Delta Epsilon Graduate Women's Scientific Fraternity will meet Saturday through Monday, December 27–29, at the Sherman Hotel. The National Council Meeting will be held on Saturday morning; a luncheon for all Women in Science, at which Marjorie Carlson will speak on "Plant Collecting in Salvador," will be held on Saturday afternoon; and the National Convention Breakfast will be held on Monday morning.

Society of the Sigma Xi will meet on Monday and Tuesday, December 29–30. A meeting of the Executive Committee will be held at 9:00 A.M. on Monday in the secretary's suite, Sherman Hotel. The Annual Convention of the Sigma Xi will be held in the Crystal Room of the Sherman Hotel on Monday evening, December 29, and the Annual AAAS-Sigma Xi Lecture will be delivered in the Grand Ballroom of the Sherman Hotel on Tuesday evening, December 30. Glenn T. Seaborg will speak on "The Eight New Synthetic Elements."

About the Press Room—

As stated on page 556 of this issue, press headquarters for the Chicago meeting will be in Parlors L, M, and O of the Sherman Hotel, with Sidney S. Negus, professor of chemistry, Medical College of Virginia, and president-elect of the Virginia Academy of Science, in charge. Dr. Negus is also a member of the National Association of Science Writers.

The preparation of facilities in the press room for the use of news reporters is under the direction of Miss Jeannette Lowrey, Office of Public Relations, University of Chicago, and chairman of the local AAAS Publicity Committee. During the meeting Dr. Negus and members of the press room staff will distribute news releases, arrange press interviews, and otherwise manage the press relations of the Association.

Speakers, who have been unable to file abstracts or manuscripts of their papers with the Press Director in advance of the meeting are requested to turn them in at the press room in Chicago at least 12 hours in advance of their presentation.

It is a general rule among science writers that, in order for a paper to qualify as news, there must be some point of contact between the subject and the public. Science writers sometimes uncover newsworthy material in the most prosaically written reports. It is much more likely that an abstract will attract the science writer and appear in print if the opening paragraph draws attention to the social aspects of the investigation or emphasizes the possible utilitarian value of the results to the public. Wholehearted cooperation is required of both scientists and science writers if the Association is to realize one of its principal goals—"to increase public understanding and appreciation of the importance and promise of the methods of science in human welfare."

Science Exhibition

The AAAS International Science Exhibition, held annually in conjunction with the meetings of the Association, will be housed this year in the Exhibition Hall of the Stevens Hotel, Michigan Boulevard and Eighth Street. The Stevens Hotel is conveniently located and can be reached easily from all points in Chicago.

The exhibition will be open on Friday, December 26, from 1:00 to 9:00 P.M.; on December 27, 28, and 29, from 9:00 A.M. to 5:00 P.M.; on December 30, from 1:00 to 9:00 P.M.; and on December 31, from 9:00 A.M. to 12:00 noon.

The exhibition always brings together displays of products and services of substantial interest to scientists. Members will find it convenient to proceed directly to the exhibition after having completed their registration in the foyer just outside of the Exhibition Hall. Admission is restricted to members and registered guests. College students may be given special passes upon application to the director of the exhibit. High school students are not admitted.

Directory of Exhibits

The standards for exhibiting at the AAAS meetings have always been high, and this year's exhibitors have qualified in every way for participation. The Association expresses appreciation on behalf of its members for the cooperation of the exhibitors in organizing an excellent series of technical and scientific exhibits.

Special Exhibits

The AAAS International Science Exhibition this year presents three special exhibits, all of which are grouped around the theme, "Photography in Science." Scientists will find these of unusual interest with regard to both the results shown and the techniques developed and displayed through the medium of finished photographs.

The First International Salon, "Photography in Science." Early in 1947 the Smithsonian Institution, Division of Graphic Arts, and the Association's publication, *The Scientific Monthly*, announced plans for a jointly sponsored photographic competition which would be restricted to scientists. The purpose of the competition was to extend the possibilities of research through functional photography. The officers of both sponsoring organizations felt that the results achieved in the first year of the competition justified the announcement of a second competition in 1948.

The First Annual Competition resulted in the submission of nearly 400 prints, two-thirds of which were in black and white and one-third in color. A great majority of these prints will be on display in the Exhibition Hall during the full time of the meeting. Information about the Second Annual Competition will be available at that time.

The Association acknowledges the assistance of the staff of the Armour Research Foundation for arranging the hanging of this exhibit.

Atomic Energy. The editors of *Life*, the national pictorial weekly, have gathered together a significant series of photographs, many of which have not been published previously, under the title of "Atomic Energy." This unique series of photographs will have its premier showing at the meetings in Chicago. The Association is indebted to the editors of *Life* not only for the large amount of time and effort which went into producing this special showing but also for their willingness to undertake it for the benefit of the members.

Biological Photography. For many years the Biological Photographic Association has been the leading association in the development of photography as a tool for biological research. At the Oklahoma City annual meeting of the BPA a number of outstanding prints were gathered together for awards and further showing through other scientific associations. The Biological Photographic Association graciously consented to send a group of 70 prints to the Chicago meetings prior to circulating them in other parts of the country. The Association expresses its appreciation for this courtesy which will enable members in all fields of science to see these excellent pictures.

The members of the exhibition staff feel that these three photography exhibits should be seen by every member in attendance at the meetings. The staff will gladly arrange to have complete technical details about any print or group of prints furnished to any member desiring this information.

American Association for the Advancement of Science. The Association, as the largest general scientific society in the country, participates in many ways in the activities of other societies. In addition, it publishes *Science* and *The Scientific Monthly* regularly. At intervals it publishes the *Association Proceedings*, which usually covers a period of four years of the Association's activities plus a directory of the membership at the time of each publication. During recent years the Association has also published more than 20 technical symposia in a variety of fields. These symposia have received wide acclaim not only for the contribution made to the research literature but for the excellence of editorial format and direction.

The Association's booth will show copies of the technical symposia which are still in print and a group of *Proceedings* from the first 100 years of the Association's operation. Members of the publications staff from the Washington office will be in attendance at all times. It is hoped that scientists who wish to publish articles in either of the journals will take advantage of this opportunity to meet the editorial personnel. Members of the Circulation Department will be on hand to receive subscriptions for the publications.

The Centennial celebration of the Association will be held in Washington, September 13–17, 1948. The Greater National Capital Committee of the Washington Board of Trade has arranged an interesting exhibit about the city of Washington and the District of Columbia. Members planning to attend the Centennial celebration in Washington will find this a convenient time to make inquiry about hotel accommodations and points of interest which they may want to visit during their stay in Washington.

Science Theater

This year for the first time the Association is sponsoring a Science Theater, the purpose of which is to emphasize the use of motion pictures in recording scientific research. Films have been submitted by academic, governmental, and industrial research organizations from all over the country, and promise to be of high quality. The films cover such a variety of subjects that the Science Theater is certain to be of interest to every member attending the meetings.

The hours during which the theater will be open are as follows: December 26, 2:00 to 5:00 P.M. and 7:00 to 9:00 P.M.; December 27, 28, and 29, 9:00 A.M. to 12:00 noon and 2:00 to 5:00 P.M.; December 30, 2:00 to 5:00 P.M. and 7:00 to 9:00 P.M.; December 31, 9:00 A.M. to 12:00 noon.

Final information concerning the schedule of films to be shown will be available at the Association booth in the Exhibition Hall. The tentative schedule follows:

Friday, December 26

2:00–5:00 P.M.

High-Speed Motion Pictures. Prof. Charles E. Locke, Massachusetts Institute of Technology. 11 minutes.

3,000 Pounds Per Square Inch. Taylor-Wharton Iron & Steel Company. 30 minutes.

Ceiling Unlimited. Aviation Department, Socony-Vacuum Oil Company. 28 minutes.

Seeing the Unseen. Prof. Charles E. Locke, Massachusetts Institute of Technology. 11 minutes.

Body Care and Grooming. McGraw-Hill Book Company. 17 minutes.

The Nose, Throat, and Ears. McGraw-Hill Book Company. 10 minutes.

The Body Fights Disease. McGraw-Hill Book Company. 15 minutes.

The Story of Reproduction. McGraw-Hill Book Company. 23 minutes.

Emotional Health. McGraw-Hill Book Company. 21 minutes.

Note: The McGraw-Hill Book Company has recently released the above 5 films. The films represent a substantial investment on the part of the Company to explore and extend the use of film as a teaching aid when used in conjunction with text material.

7:00–9:00 P.M.

Malaria in Monkeys. Dr. Melvin H. Knisely, Department of Anatomy, University of Chicago. 2 hours.

Saturday, December 27

9:00 A.M.–12:00 noon

Dental Silicate Cement. National Bureau of Standards. 18 minutes.

Title to be announced. University of Maryland Dental School.

Malaria in Monkeys. Dr. Melvin H. Knisely, Department of Anatomy, University of Chicago. 2 hours.

2:00–5:00 P.M.

Energy Release From Food. The Upjohn Company. 26 minutes.

Effect of Drugs on the Heart in Situ. Dr. R. P. Walton, Medical College of the State of South Carolina. 32 minutes.

The Medical Motion Picture—Its Development and Present Application. American Medical Association. 32 minutes.

Keratoplasty—Circular Transplant Technic. Dr. Ramon Castroviejo, The Institute of Ophthalmology, Columbia Presbyterian Medical Center. 15 minutes.

Keratoplasty—Square Transplant Technic. Dr. Ramon Castroviejo, The Institute of Ophthalmology, Columbia Presbyterian Medical Center. 18 minutes.

Precancer Diagnosis of Cervix by Cytology. Gyne-cytology Laboratory, Royal Victoria Hospital, Montreal, Canada. 19 minutes.

Sunday, December 28

9:00 A.M.–12:00 noon

Continuous Spinal Analgesia in Caesarean Section. Dr. John C. Ullery, Philadelphia. 15 minutes.

Open Drop Ether. British Information Services. 31 minutes.

Nitrous Oxide-Oxygen-Ether Anaesthesia. British Information Services. 27 minutes.

The Carbon-Dioxide Absorption Technique. British Information Services. 24 minutes.

Signs and Stages of Anaesthesia. British Information Services. 23 minutes.

Endotracheal Anaesthesia. British Information Services. 26 minutes.

2:00–5:00 P.M.

Operative Shock. British Information Services. 16 minutes.

Respiratory and Cardiac Arrest. British Information Services. 15 minutes.

Handling and Care of the Patient. British Information Services. 26 minutes.

Spinal Anaesthesia. British Information Services. 34 minutes.

Intravenous Anaesthesia, Part I. British Information Services. 30 minutes.

Intravenous Anaesthesia, Part II. British Information Services. 25 minutes.

Note: All of the films shown in this symposium on anaesthesia were made available to the exhibition through the courtesy of the British Information Services. The exhibition staff is particularly pleased to present them at this time not only as evidence of the international exchange of scientific information but also for the purpose of showing what scientists in other countries are doing.

Monday, December 29

9:00 A.M.–12:00 noon

Magnesium—Metal From the Sea. Bureau of Mines. 23 minutes.

Synthetic Rubber. Bureau of Mines. 21 minutes.

Body Care and Grooming. McGraw-Hill Book Company. 17 minutes.

The Nose, Throat, and Ears. McGraw-Hill Book Company. 10 minutes.

The Body Fights Disease. McGraw-Hill Book Company. 15 minutes.

The Story of Reproduction. McGraw-Hill Book Company. 23 minutes.

Emotional Health. McGraw-Hill Book Company. 21 minutes.

2:00–5:00 P.M.

Light Control Through Polarization. Polaroid Corporation. 20 minutes.

High-Speed Fastax Camera. Bell Telephone Laboratories. 15 minutes.

Drama of Steel. Bureau of Mines. 34 minutes.

Lubrication. Bureau of Mines. 30 minutes.

Magnetic Recording. Armour Research Foundation.

Counter Gravity Casting. Armour Research Foundation.

Radio Frequency Heating. RCA Laboratories.

Image Orthicon. RCA Laboratories.

Tuesday, December 30

2:00–5:00 P.M.

Arizona—Its Mineral Resources and Scenic Wonders. Bureau of Mines. 40 minutes.

Evolution of the Oil Industry. Bureau of Mines. 34 minutes.

Dental Silicate Cement. National Bureau of Standards. 18 minutes.

Title to be announced. University of Maryland Dental School.

Use of the Calf for Surgical Training and Research. Dr. Ivan E. Martin, Los Angeles.

Explosions on the Sun. Harvard College Observatory and University of Colorado. 12 minutes.

7:00–9:00 P.M.

Photography as an Aid to Mine Development. Naval Ordnance Laboratory.

Magnetic Recording. Armour Research Foundation.

Counter Gravity Casting. Armour Research Foundation.

High-Speed Fastax Camera. Bell Telephone Laboratories. 15 minutes.

Drama of Steel. Bureau of Mines. 34 minutes.

Wednesday, December 31

9:00 A.M.–12:00 noon

Repeat showing of selected films by special request.

Science Library

Continuing a practice developed by the AAAS International Science Exhibition many years ago there will be a cooperative display of new books and established text and reference works submitted by the leading publishers in the United States. This year the Science Library will be managed by the Illinois Chapter of the Special Libraries Association. This group of librarians will arrange the displays and have the library staffed with librarians well versed in the publications and literature of all major fields of science.

A special feature of the library this year will be a display of a group of standard reference books selected by a committee of librarians.

The following publishers have indicated that selected books published by them will be available for inspection during the meetings: Academic Press, Inc.; Annual Reviews, Inc.; The Blakiston Company; Boni & Gaer, Inc.; Chemical Publishing Co.; Chronica Botanica Co.; Columbia University Press; Comstock Publishing Company; Cornell University Press; Crown Publishers; D. Appleton-Century Company, Inc.; Dodd, Mead & Company, Inc.; Garlan Publications; Harper & Brothers; Harvard University Press; D. C. Heath and Company; Henry Holt & Co.; Houghton Mifflin Company; Interscience Publishers, Inc.; Iowa State College Press; Journal of Chemical Education; Lea & Febiger; Longmans, Green & Co., Inc.; McGraw-Hill Book Company, Inc.; The Macmillan Company; The C. V. Mosby Company; Philosophical Library; Pitman Publishing Corporation; Princeton University Press; Reinhold Publishing Corporation; W. B. Saunders Company; Peter Smith; Stanford University Press; University of Chicago Press; University of Wisconsin Press; D. Van Nostrand Company; The Viking Press, Inc.; John Wiley & Sons, Inc.; and Yale University Press.

In many instances the books shown in the Science Library are only a portion of the total list of titles published by each firm. Complete catalogues may be secured by leaving such a request with the librarian in charge. Many of the firms depositing books in the Science Library also have more complete displays in their own booths. Visitors to the Science Library are urged to visit these other booths to examine current publications.

Allyn and Bacon

Boston, Massachusetts

Booth No. 5

Allyn and Bacon beg leave to call special attention to their complete 12-year science series to be on exhibit. This series includes the *Rainbow readers* and *Workbooks* for the first 6 grades, followed by Carpenter and Wood's *Our environment series* for the junior high school years, and Smallwood's *Biology*, Fuller, Brownlee, and Baker's *Physics*, and Brownlee and others' *Chemistry*. Several of these books are national leaders. All are provided with workbooks and teachers' manuals.

American Optical Company

Buffalo, New York

Booth No. 1

The American Optical Company, Scientific Instrument Division, manufacturers of Spencer instruments, will have on display the following: new accessories for Spencer Phase Microscope, which utilizes optical path differences of unstained, transparent material to show sharp outline and internal detail at full resolution; a new Spencer Stereoscopic Shop Microscope; a new 2" x 2" slide projector with coated optics and self-centering slide carrier; also, new self-centering slide carriers for current Spencer Delineascopes. In addition, a selection of well-known Spencer instruments will be shown and demonstrated. Messrs. J. J. Host, G. W. Frid, G. E. Guellich, R. W. Schmader, and a full staff will be in attendance to discuss any optical questions presented.

Armour and Company

Chicago, Illinois

Booth No. 51

High molecular weight aliphatic compounds and crystallized proteins of recent development will be displayed by the Chemical Research and Development Department of Armour and Company. Among the high molecular weight aliphatic compounds will be ketones, amidoesters, quarternary ammonium chlorides, tertiary amines, tertiary amine oxides, and a dimeric nitrile. The crystallized proteins will feature bovine plasma albumin and several crystallized enzymes, pepsin, trypsin, chymotrypsin, lysozyme, and ribonuclease. Technical information and possible applications will be available on these and related materials, such as fibrinogen, adenosine triphosphate, bilirubin, and Armour Catalase, technical grade.

Bausch & Lomb Optical Company

Rochester, New York

Booth Nos. 79, 80, and 81

The Bausch & Lomb Optical Company booth will be given over primarily to the exhibition and demonstration of four of the latest developments in the field of microscopy. The new series of Bausch & Lomb microscopes with Variable Focus Condenser provides, for the first time, quick, accurate focusing of microscope substage illumination. With the new condenser, the area of the illuminated field is increased and the numerical aperture of the beam decreased by merely racking the condenser down. In a companion demonstration, the new Bausch & Lomb Phase Contrast Microscope Accessories will be shown. You are invited to bring in your own unstained preparations for your personal examination with phase contrast. Comparative photomicrographs of a wide selection of living material will also be available for study. The B & L Fluorescence Microscope Accessories for tubercle bacilli detection will also be shown. This method is applicable to both smears and tissues stained with auramine. Balcoted Microscope parts will be displayed for your examination.

Biological Abstracts

Philadelphia, Pennsylvania

Booth No. 7

A cooperative, nonprofit journal published by biologists for biologists, *Biological Abstracts* is the only abstracting and indexing service in the world that affords an adequate coverage of the literature in all fields of biology. Currently abstracting some 2,700 journals, the coverage is being expanded as rapidly as possible to include the many European, Scandinavian, and Asiatic journals that have not been available to the scientists of this country since the outbreak of the war. *Biological Abstracts* is published both in a complete edition and in 9 low-priced sectional editions especially designed for individual biologists who are interested only in one or more closely related fields. These sectional editions will be on display, and Dr. John E. Flynn, editor-in-chief, and H. I. Anderson, business manager, will be in attendance to welcome visitors and furnish information.

The Blakiston Company

Philadelphia, Pennsylvania

Booth No. 50

The Blakiston Company, Philadelphia and Toronto, will display a wide selection of science textbooks representing both the undergraduate and research fields. Among the textbooks visitors should examine are: Emerson, *Basic botany*; Hoff, *Secondary-school science teaching*; Lille, *Histopathologic technic*; Foley-Glathart, *College physics* (4th ed.); Mettler, *History of medicine*; Dethier, *Insect attractants & repellents*; Edwards, *Concise anatomy*; Chester, *Nature & prevention of plant diseases* (2nd ed.). Attendants will be glad to discuss new manuscripts and additional forthcoming books.

Wm. C. Brown Company

Dubuque, Iowa

Booth No. 139

This company will have on display all of its latest publications, including laboratory manuals, workbooks, and outlines in the fields of biology, zoology, botany, home economics, physics, chemistry, engineering, and medicine. Complete series of the popular Pictured-Key Nature books will also be available for inspection. Booklets will be available at the booth of this company giving complete information concerning its specialized publishing service.

Burgess Publishing Company

Minneapolis, Minnesota

Booth No. 105

This will be an educational book display by one of the few established photo-offset and mimeoprint book publishers in the country. Specialists in the publishing of small-run editions for college and university courses, Burgess offers the instructor, the department head, or the organizational scientist an opportunity to publish his own text or manual in quantities as small as 100. Burgess books are reproduced by superior quality photo-offset and mimeoprint processes. The type is clean, distinct, and easy to read. Illustrations reproduce sharply and clearly. Full details will be available at the booth, and many Burgess volumes, now adopted by hundreds of colleges and universities throughout the country, will be on display.

Central Scientific Company

Chicago, Illinois

Booth Nos. 27 and 28

Cenco invites all of those in attendance to visit booths 27 and 28. Here will be shown new apparatus for laboratory workers in physics, chemistry, and biology. The display will include the A.C.-operated Cenco Titration-pH Meter, the Cenco 5″ Oscilloscope in connection with the Cenco Electronic Switch and Multiple Input Audio Frequency Amplifier and Permanent Magnet Speaker, new Cenco Dial Resistance Boxes and Decade Condensers, the Cenco "Photelometer," Concentrated-Arc Lamps, the Polaroid Polariscope, new Bakelite Boxes that hold 100 microscope slides, Cenco High Vacuum Pumps, and other items. Selective Experiments in Physics which permit the instructor to make a selection of experiments most suitable for his course will also be featured. Members of the Cenco staff will be in attendance to greet friends and to discuss apparatus.

Chicago Apparatus Company

Chicago, Illinois

Booth No. 69

The Chicago Apparatus Company, manufacturers and distributors of scientific laboratory supplies for educational and research institutions, will exhibit for the Physics Department a new stroboscope, a new electric atom model, and a practical teaching model of the oscillograph; for the chemists, research models of analytical balances, Beckman pH Meters, precision heaters, and the new metal heating mantles of the Glas-Col Company; and for the Biology Department, the chick embryo model as well as the latest model microscopes. You are cordially invited to discuss your problems with either of the three representatives, Messrs. F. D. McCally, John Geisel, and Lee Tennis.

Thomas Y. Crowell Company

New York, New York

Booth No. 133

The Crowell booth will display publications of both its College Department and its Trade Department. Books published in 1947 will be featured, but all established publications issued previously will also be exhibited. Noteworthy recent books include: *Semimicro qualitative organic analysis*, by Cheronis and Entriken; *Basic college chemistry*, by Babor; *Physical chemistry*, by Hunt; *First year qualitative analysis*, by Likes and Harvey; *Exercises in organic synthesis*, by Sharefkin; *Experiments in science*, by Beeler and Branley; and *Famous men of science*, by Bolton.

Denoyer-Geppert Company

Chicago, Illinois

Booth Nos. 131 and 132

Denoyer-Geppert Company will have a display of anatomical and biological models, demonstration mounts, skeletons, corrosion specimens, Kodachrome slides, and charts for anatomy and biology.

Eastman Kodak Company

Rochester, New York

Booth No. 55

The Eastman Kodak Research Laboratories are engaged in an extensive research program on photographic materials for nuclear research work and also for the making of autoradiographs. The central features of the display will be photographs and transparencies showing results obtained with special photographic plates designated as Kodak Nuclear Track Plates. Typical examples of original slides will be available for examination under a microscope. Also included are photographs and transparencies of other applications of photography in science, such as photomicrography, electron microscopy, and photography in astronomy.

Edmund Salvage Company

Collingswood, New Jersey

Booth Nos. 35 and 36

The Edmund Salvage Company, which has specialized in retailing war-surplus optical items, will display a great variety of lenses and prisms. In addition, there will be telescopes, periscopes, and gun sights through which visitors may look. War-surplus bubble sextants, both new and used, will be on display along with astro compasses and drift meters. Beautiful desk name plates made from tank prisms will interest every scientific-minded person who visits the booths. Variable density polarizing filters will be available so that you may rotate them. You have probably read and heard a lot about the Navy's infrared snooperscope units. These will be on display at our exhibit so that you will be able to see for yourself how they work.

Gamma Scientific Company

New York, New York

Booth No. 43

The exhibit of the Gamma Scientific Company will feature the domestically manufactured products of its affiliate, Gamma Instrument Company, and also a number of recently imported items. Among the former will be the latest model of the well-known Microflex Photomicrographic Mirror Reflex camera, featuring all metal construction. A wide number of accessories for this camera such as the new Gamma Dura-Color Filter Set, illuminating devices for low-power photography in transmitted light and for macrophotography in reflected light will also be shown. Also on display will be the newly introduced photomicrographic desk, a complete line of Gamma pH meters for routine and research work, the Gamma Chambers' Micro-Manipulator and accessories. Among the imported items which will be demonstrated will be a Refractometer, a Polarimeter, and Precision Balances with air damping.

Garden City Engineering Specialty Company

Chicago, Illinois

Booth No. 46A

The Serdex Indicating Hygrometer and Microhygrograph (relative humidity), Dillon Bimetal Industrial Dial Thermometers, *ASTM Thermometers, API Hydrometers, a complete* line of precision, standard, and technical grade mercury in glass thermometers, Industrial Thermometers, Dial and Recording Thermometers, and Dial and Recording Pressure Gauges will be on display. Messrs. John C. Hayes, E. A. Johnson, and C. C. Hurst will be in attendance.

General Biological Supply House, Inc.

Chicago, Illinois

Booth Nos. 57 and 58

The Turtox booths will feature cultures of Protozoa, molds, and bacteria displayed by microprojection, and living marine specimens in tanks of sea water. A large collection of Kodachrome color transparencies will be on display and will be projected continuously. In addition, the entire series of more than 300 Turtox C-R Biological Charts and many recently published biological drawings in the series of Key Cards and Quiz Sheets will be available for inspection.

Gradwohl School of Laboratory Technique

St. Louis, Missouri

Booth Nos. 67 and 68

The display will be, as usual, in charge of Mrs. A. G. Erskine. Visitors will be welcome and will have every opportunity to discuss their problems. The display will consist of a photographic representation of many laboratory activities carried on in this school. Full literature will be available. Registrants are requested to leave their names and addresses for further particulars.

The Graf-Apsco Company

Chicago, Illinois

Booth No. 40

The exhibit of the Graf-Apsco Company is featuring rebuilt microscopes and microtomes and related supplies such as micro slides, cover glasses, magnifiers, etc. A complete line of dissecting and surgical instruments will also be displayed.

Harper & Brothers

New York, New York

Booth No. 64

Harper & Brothers will have on display all of their current college textbooks in the physical and biological sciences, mathematics, and psychology, as well as a number of medical books published by Paul B. Hoeber, Inc. (the Medical Book Department of Harper & Brothers) and many general trade books of interest to scientists. Particular attention is called to the new *Personality: a biosocial approach to origins and structures*, published in August, and *The essentials of plant biology*, by Frank D. Kern. The latter is a new textbook for the one-semester botany course, which has come from the press just in time to be included in the display.

W. A. Hammond Drierite Company

Xenia, Ohio

Booth No. 12

Industrial, laboratory, and home applications of Drierite, in its Regular, Indicating, Du-Cal, and Moulded forms, will be displayed. A miniature two-tower drying unit, compartment desiccators for home and industrial use, new laboratory gas dryer, and a new, small, compressed air line dryer containing throw-away cartridges will be featured. Many other useful applications of this product of science will be described or portrayed. Company personnel will be present to discuss the technical aspects of Drierite.

Instrument Development Laboratories

Chicago, Illinois

Booth No. 92

Instruments for the measurement of radioactivity will be the theme of Instrument Development Laboratories' exhibit. Pocket-size, portable and semiportable instruments for qualitative and quantitative determination of Alpha, Beta, and Gamma radiation will be in operation. Instrument Development Laboratories' new countomatic scaling unit will be on display, demonstrating flexibility of this automatic machine. The new Geiger counter, fountain pen dosage meters, and other radioactivity monitors for research, health monitoring, and geological surveying will also be shown. Engineers will be at the booth daily to suggest solutions to your instrumentation problems.

Jarrel-Ash Company

Boston, Massachusetts

Booth No. 71

Jarrel-Ash Company will feature an inexpensive spectrograph, source unit, and microphotometer with ample dispersion, resolution, and sensitivity for all spectrochemical analysis of biological or clinical materials. The equipment is suitable also for general spectrochemical work and for instruction in special methods in chemical analysis. Specialized optical instruments will include a Bellingham and Stanley Glass Circle Polarimeter reading to .01° and a less expensive Bellingham and Stanley instrument reading to .05°; a Bellingham and Stanley Standard Abbe Refractometer with glass scale read by transmitted light; a Projection Refractometer for the food industry; a Hilger-Mueller Double Monochromator f/4.0, 1,850A. to 40,000A., with accurate wave length scale. Microscopic equipment displayed will include metallurgical, polarizing, research, and stereoscopic microscopes available for immediate delivery. There will also be a Precision Rotary Microtome, a photomicrographic camera, the new high-intensity Zirconarc for work at high magnification, and fluorescent lamps for low-power work.

W. H. Kessel & Company

Chicago, Illinois

Booth No. 18

On display for demonstration will be microscopes of various types and accessories, photomicrographic cameras, light sources for photomicrography, photometers for exposure determinations, refractometers, pH meters, photoelectric and duboscq colorimeters, as well as laboratory instruments.

E. Leitz, Inc.

New York, New York

Booth No. 14

Leitz will show their Universal Microscope and Photomicrographic Apparatus "Panphot," which features a distinct departure from the conventional type of photomicrographic apparatus. The first postwar model of the Leitz Research Microscope, "Ortholux," will be displayed for the first time. This instrument is equipped with a built-in light source and can be used not only for transmitted but also for reflected light. Standard monocular as well as binocular medical microscopes will be on display, as well as the well-known Photoelectric Colorimeter. Another feature will be the Leica Camera and its accessories for gross photography, photomicrography, and copying in both black and white and color.

Linguaphone Institute

New York, New York

Booth No. 4

Linguaphone presents the study of foreign languages in its most scientific form—coordination-association of the sight of an object with the sound of the word it represents. A Linguaphone course comprises a series of synchronized phonograph records and books. While listening to the lesson on the record the student follows each word in the illustrated text, training eye and ear together. These lessons, graded in speed and subject matter, are recorded by both male and female voices. Supplementary books give full grammatical instruction. The records provide pronunciation and intonation. The result is fluency in thinking in the language in an amazingly short time. Linguaphone courses are available in 29 languages. The Linguaphone electric phonograph, fitted with earphones to ensure uninterrupted study at any time, will be displayed, as will the Classophone record-filing system, which can be installed in any bookcase or cabinet and which is the simplest, most practical method for protecting and classifying phonograph records.

McGraw-Hill Book Company, Inc.

New York, New York

Booth Nos. 52 and 53

The McGraw-Hill Book Company invites you to visit booths 52 and 53, where you will find recent and standard texts and reference books in agriculture, botany, chemistry, forestry, geology, health education, physics, psychology, and zoology. We urge that you check these authoritative, timely volumes and place your order for examination copies of those titles which are of interest in your particular program.

The Macmillan Company

New York, New York

Booth Nos. 2 and 3

The book exhibit sponsored by the Macmillan Company will consist of approximately 800 titles, including publications of the Cambridge University Press. In addition to undergraduate and graduate textbooks and reference works, there will be a large number of technical and scientific books of interest to the general reader. Books in the fields of various hobbies and avocations—photography, gardening, radio, outdoor life, and others—will be represented along with books of special interest to young readers. The major classifications are Agriculture, the Biological Sciences, Chemistry, Engineering, History and Philosophy of Science, Home Economics, Mathematics, Medical Science, and Physics. Representatives of the Macmillan Company at this exhibit will be Mr. Tyler Buchenau, science editor; Mr. C. J. Hylander, visual aids editor; Mr. Paul A. Carlson, Mr. Robert B. Davis, and Mr. Joseph G. Sutton, Jr.

G. & C. Merriam Company

Springfield, Massachusetts

Booth No. 106

The G. & C. Merriam Company exhibit will consist of a sample display of the various publications of the company, which are as follows: Webster's *New international dictionary* (2nd ed.), Webster's *Collegiate dictionary* (5th ed.), Webster's *Dictionary of synonyms*, and Webster's *Biographical dictionary*. In addition, there will be displayed for distribution copies of various pamphlet material dealing with instruction in, and the use of, the various books mentioned above. Souvenirs will be provided.

The C. V. Mosby Company

St. Louis, Missouri

Booth No. 24

Visitors to the International Science Exhibition are cordially invited to examine the books on display at the C. V. Mosby Company booth. Among the titles on display will be the following new releases: Rogick, *General zoology laboratory manual*; Bellafiore, *Pharmaceutical arithmetic*; Novak-Meyer, *Bacteriology laboratory directions for pharmacy students*; Schaub-Foley, *Diagnostic bacteriology*; Potter, *Textbook of zoology*; Atwood, *A concise comparative anatomy*; Cureton, *Physical fitness, appraisal and guidance*; Turner, *School health and health education*; and Iddins, *Workbook for physical education*. The complete line of Mosby texts and reference books will also be exhibited.

National Geographic Society

Washington, D. C.

Booth Nos. 82 and 83

The exhibit will show one of the battery of huge telescope cameras focused on the eclipse of the sun by the Army Air Forces-National Geographic Society Solar Eclipse Expedition at Bocaiuva, Brazil, May 20; also, samples of rock from submarine mountains in the Atlantic Ocean, dredged up last summer by the Mid-Atlantic Ridge Expedition sponsored by the Society, Columbia University, and the Woods Hole Oceanographic Institution. Photographs illustrating interesting features of the Society's recent scientific projects will form a fascinating backdrop for the exhibit.

Philosophical Library

New York, New York

Booth No. 8

Visitors to the Exhibition are cordially invited to visit the booth of the Philosophical Library. Some of the books which will be featured are: *The selected writing of Benjamin Rush*, by

Dagobert D. Runes (editor); *Existentialism*, by Jean-Paul Sartre; *How our minds work*, by C. E. M. Joad; *Hindu philosophy*, by Theos Bernard; *The new dictionary of psychology*, by Philip Lawrence Harriman; *Unusual words and how they came about*, by Edwin Radford; *Studies in genius*, by Walter G. Bowerman; *Old Korea*, by Elizabeth Keith; *Physics of the 20th century*, by Pascual Jordan; *Science since 1500*, by H. T. Pledge; *Charles Darwin and the voyage of the Beagle*, edited by Lady Nora Barlow; *The tyranny of time*, by Chalinder Allen; *The dictionary of philosophy*, edited by Dagobert D. Runes; *Essays in science and philosophy*, by Alfred North Whitehead; *Spinoza portrait of a spiritual hero*, by Rudolf Kayser; *The great beyond*, by Maurice Maeterlinck; *The creative mind*, by Henri Bergson; *Logic for the millions*, by A. E. Mander; and *Narcotics and drug addiction*, by Erich Hesse, M.D.

Alvin F. Polan
Baltimore, Maryland
Booth No. 25

The specimens of plants, insects, and animal tissue in this exhibition are preserved by a quick process which fixes the actual color and physical appearances of the specimens indefinitely. The specimens that are exposed to the air will not decay or disintegrate and many retain their natural odor. There are no signs of the preservative treatment on the subject matter after processing the specimens.

Prentice-Hall, Inc.
New York, New York
Booth No. 42

Prentice-Hall, which will be represented by Associate Editors Frank Bitner and Warren Blaisdell, will feature a display of over 100 College and Industrial Department books in the fields of chemistry, physics, mathematics, engineering, geology, and geography, psychology, and statistics. New books which will be available will include *Advanced calculus*, by David V. Widder; *College algebra*, by Moses Richardson; and *Mental hygiene*, by Herbert A. Carroll. By arrangement with the Editorial Department page proofs on important forthcoming texts, including *Organic chemistry*, by Ray Q. Brewster, will be available for inspection.

Radiation Counter Laboratories, Inc.
Chicago, Illinois
Booth No. 66

Instruments for measurement of radioactivity will be shown

W. B. Saunders Company
Philadelphia, Pennsylvania
Booth Nos. 72 and 73

The W. B. Saunders Company cordially invites visitors to the Exhibition to stop in at booths 72 and 73, where a fine selection of our publications will be displayed. Our representatives will be glad to show you the many new books and new editions which have been published in 1947. Botanists will be particularly interested in the new (2nd) edition of Weatherwax' *Plant biology*. The brand new *General botany laboratory book*, by Dr. Edward M. Palmquist and Dr. Loren C. Petry, can be used to very good advantage with Dr. Weatherwax' book or with any other standard text. Another new book of interest to all is Dr. Ernest Gardner's *Fundamentals of neurology*. The 1947 editions of Ranson-Clark's *Anatomy of the nervous system* and of Rice's *Textbook of bacteriology* may also be seen. The new (21st) edition of *American illustrated medical dictionary*, containing over 2,000 new words, will be of interest to all scientists. The representatives present during the Exhibition will be Messrs. O. G. Enstrom, James B. Finn, C. O. Wheeler, and E. R. Zieber.

Schering Corporation
Bloomfield, New Jersey
Booth No. 6

The Schering exhibit will feature the newly discovered principle of sulfonamide therapy which practically eliminates any danger of toxicity from "sulfa" drugs. The result of laboratory and clinical researches supported by Schering Corporation, of Bloomfield and Union, New Jersey, this discovery is based on increased solubility through the use of a mixture of three sulfonamides, resulting in increased effectiveness with decreased renal toxicity and crystalluria. The concentration or solubility of one sulfonamide in a solution does not affect, and is not affected by, the amount of another sulfonamide in the same solution. This holds true if there are three sulfonamides present. Thus, only one-third of the usual dosage of each sulfonamide need be given to obtain a potentiated therapeutic effect. The probability of crystalluria when full dosage of any one drug is given is also nearly eliminated. Combinations have proven more effective, in shorter periods of time, with smaller changes. Schering's Combisul tablets or liquid are mixtures of sulfadiazine, sulfathiazole, and sulfamerazine in equal parts. Lehr substantiated these facts through original work, purposely avoiding alkalization, and found that crystalluria still does not occur. Flippen declared that alkalization may destroy some of the sulfonamides' effectiveness.

Tracerlab, Inc.
Boston, Massachusetts
Booth No. 19

The Tracerlab exhibit features the Autoscaler, a fully automatic radioactivity counting instrument. The output circuit of the Autoscaler is coupled to a large neon bulb counting indicator to permit visitors to watch the progress of demonstration radioassays. In addition, the exhibit will include the "64" scaler and radioactivity health survey and monitoring instruments together with a full line of accessories for radioactivity work including G-M tubes, sample changers, and specialized chemical equipment.

Copies of *Tracerlog*, a technical monthly publication dealing with all phases of radioactivity, and bulletins describing equipment and services of Tracerlab, Inc., will be available for free distribution.

Representing the company at the exhibit will be Mr. Dana W. Atchley, Jr., sales manager; Mr. Alan P. Schreiber, sales engineer; and Mr. Walton C. Wickett, Western representative.

The Technicon Company

New York, New York

Booth Nos. 48 and 49

The Technicon booth will feature the new Technicon Automatic Fraction Collector for Chromatographic Analysis. This is a machine which collects specific quantities of effluent fluid from the chromatographic column. The machine will automatically distribute as much as 4,000 cc. of fluid in as many as 200 test tubes, automatically placing a set and rigidly controlled amount in each tube. The automatic tissue-processing machine, the Autotechnicon, as well as the Lab-Aid slide filing cabinets, and the Scopicon, a microscopic projector, will be shown. The Technicon Automatic Pipette Washer and the Technicon Constant Temperature Water Bath for spreading paraffin sections will also be exhibited.

University Presses

Chicago, Illinois

Booth No. 97

The University Presses, leaders in the field of nonfiction, each year publish a large number of important titles. Many of these gain lasting recognition as reference books and college texts. Many also enjoy wide popularity as trade publications. All are reaching a constantly increasing audience. The exhibiting of books from University Presses is an outgrowth of the Association of American University Presses. Each press represented is a separate publishing company devoted to the production of important technical and scholarly works which might otherwise go unpublished, as well as general books of vital interest to all Americans. Because of their common goals, and because some of them are too small to sponsor exhibits alone, these presses have combined to present their books in a single impressive display.

W. M. Welch Manufacturing Company

Chicago, Illinois

Booth Nos. 102, 103, and 104

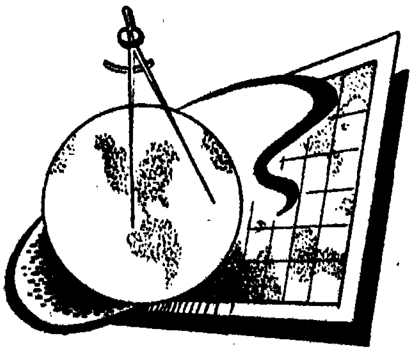
A variety of laboratory equipment and supplies will be shown. Of interest to physicists will be vacuum pumps and gauges, voltmeters, ammeters, wattmeters, ohmmeters, and A.C. and D.C. instruments in three accuracy ranges; student and demonstration equipment for mechanics, heat, electricity, sound, and light; balances, both analytical and stainless steel; chart of electromagnetic wave gamut; aeronautics charts; wind tunnel; replica gratings; and spectrometer. Equipment for use in the field of chemistry will include glassware, hardware, rubberware, straight-jacket condenser, balances, the 1947 edition of the Hubbard Periodic Chart, and Chart of Organic Chemistry. The biological sciences will be represented by a display of living and preserved specimens; microscopes; prepared slides; charts of physiology, health, hygiene, safety, and first aid; and botanical and zoological charts.

John Wiley & Sons, Inc.

Philadelphia, Pennsylvania

Booth No. 95

John Wiley & Sons, Inc., New York scientific and technical publishers, will utilize their centrally-located booth for displaying a comprehensive collection of late and standard books in various fields of pure and applied science. While stress will be laid on 1947 publications, Wiley plans to show a full range of titles which have earned recognition as outstanding texts, manuals, handbooks, or other works of reference. Many of these will be found in new, revised editions. Fields of interest covered will include aerodynamics, agriculture, anthropology, astronomy, the biological sciences, chemistry, education, the earth sciences, mathematics, public health, physics, psychology, social and political science, and business.



Obituary

Otis William Caldwell

1869–1947

"Our lives," said Dr. Caldwell, "are for what we may do, not for what we have done." To this design for living he adhered faithfully until the very end, which came on July 5, 1947.

Otis Caldwell blazed a trail in the two great enterprises of the modern world—science and education. For him the two enterprises were one. That was the essence of his outlook and of his contribution. Along every part of the trail, which stretches back more than half a century, he was surrounded with friends and followers whom he attracted and inspired.

While it is customary to trace a man's career from youth onward, Caldwell's work can be better understood by reversing that direction. The great concern of his later years was the American Association for the Advancement of Science. He held the post of general secretary, to which office he gave every ounce of his abundant energies and every facet of his fine mind. This was the golden opportunity of his life. He regarded our association of scientists as the most potent single force in the life of the Nation. He suffered a sense of hurt when scientists were ignored by statesmen. To make them understand what science can do for society became the absorbing interest of his life. There were two things to be done: Scientists themselves must be persuaded to give some of their precious time to the problems of people, and the people must become more aware of the new world being built by science. "What science may *do for men* is not enough," said Caldwell. "This must become subordinate to what science may *do to men*. Knowledge must be directed toward common needs of common men as well as toward the advancement of knowledge itself."

As general secretary, Caldwell was largely responsible for the AAAS Committee on the Place of Science in Education. Having experienced both the joys and the tribulations of the laboratory scientist, he understood why the man of science is reluctant to move out of his field of special competence. Yet his charm of manner and his wisdom brought top-rank scientists to his side in the work of improving science teaching in schools and colleges. Having been a professor of education, Caldwell was also "at home" with school administrators and educationists. To these groups he brought the essence of the scientific spirit, demonstrating the need for it in curriculum construction and in educational procedures. Thus, he helped to bring together two fields which diverge too often, to the detriment of both. In the last year of his life Caldwell was invited by the National Society for the Study of Education to write the capstone chapter in *The 46th yearbook*, devoted to science education in American Schools. The chapter closes with this paragraph:

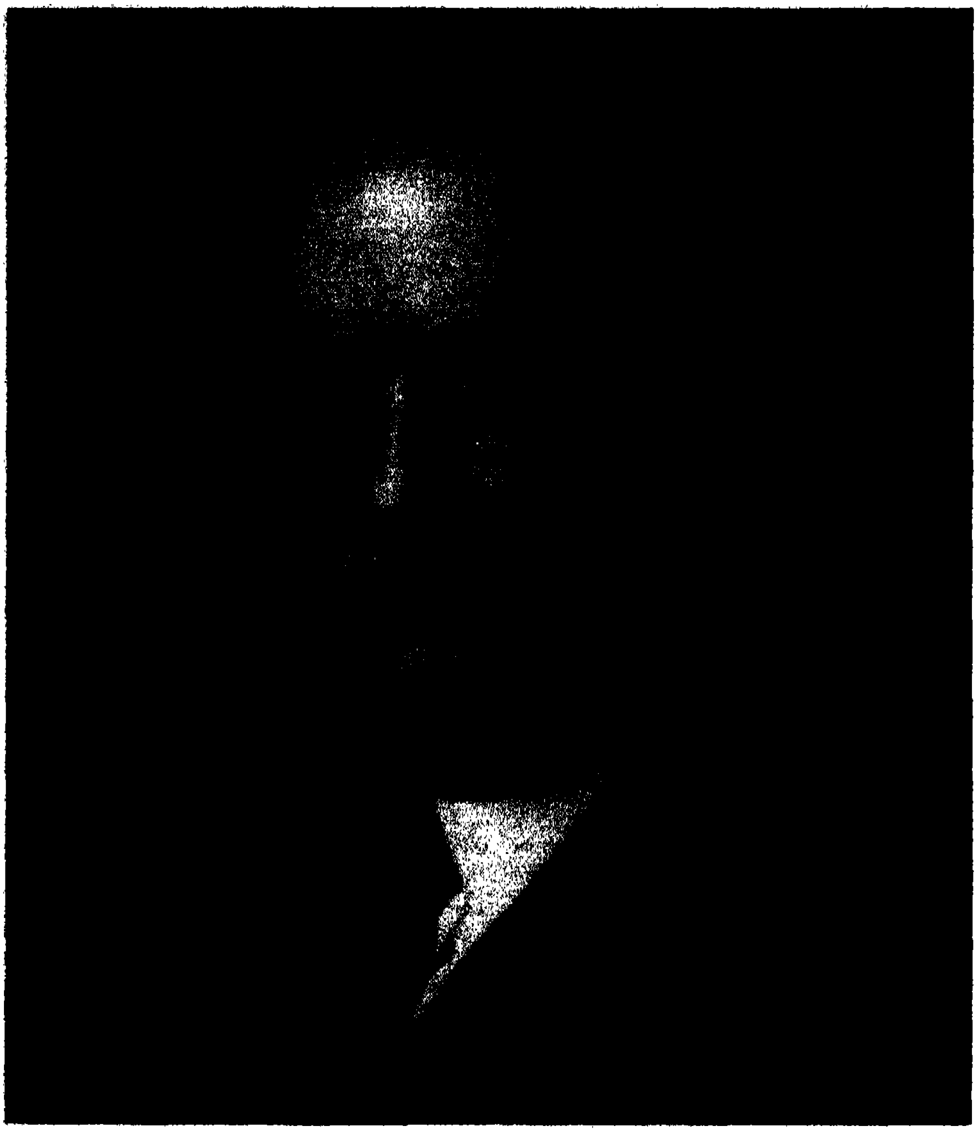
> Science education, therefore, seems imperative if society seeks security. Yet science education can not guarantee security. Security rests not only in men's knowledge but in their characters. The will to do what is right transcends knowledge of how to do what is right. Science may contribute knowledge and understandings. Their ways of working may exhibit the unprofitableness of errors, but educated human character must assume the decisive role in civilization's future.

The State Academies of Science and the Junior Academies of Science were another fertile field for the energies of the general secretary. By persistence and eloquence he heightened the interest of the Association in this work. Through unceasing effort he brought scientists, teachers, and youth together in many states throughout the Nation. This work with young people was the precursor of the science club movement and of science talent searches. The AAAS Committee on Junior Scientists Assembly was inspired by Dr. Caldwell. The first of these Assemblies, held in Boston in December 1946, created unusual interest. For the first time, young scientists were welcomed to take part in the program of adult scientists. Caldwell saw clearly the need for continuous recruitment of youth to the ranks of science. He was appalled at the losses in scientific personnel brought about by the war, and he feared the impending shortages of scientists and technologists.

The AAAS-George Westinghouse Science Writing Awards were another Caldwell project. His concern with "science in our lives" had led him early to an examination of newspapers, magazines, and world affairs. His famous study, "Biology in the Public Press," was a pioneering effort that touched off many similar studies. In these annual awards to science writers Caldwell found new opportunities to bring good science to all the people.

Dr. Caldwell was the patron saint of the AAAS Cooperative Committee on Science Teaching and the founder of the National Science Teachers Association. This group, numbering several thousand science teachers and teaching scientists, is an affiliate of the AAAS and, at the same time, the department of science instruction of the National Educational Association.

When Caldwell was 75, a group of his colleagues and



OTIS WILLIAM CALDWELL

former students (he called them his Dependable Associates) prepared manuscripts for a brochure entitled *Looking ahead in education*. This was published by Ginn and Company in 1945 and has had wide national circulation. In each chapter of this work we find a bit of the essence of Caldwell's outlook on life. Scientists, teachers, psychologists, mathematicians, administrators, sociologists, and economists all join in projecting his philosophy into the future. They point up the Caldwell drive toward an education for our times based upon imagination and intelligence and recognizing the vital role of science in social progress.

When Caldwell reached 70 years of age, another group of faithful friends compiled a volume of greetings which expressed the deep appreciation of 150 loyal colleagues, grateful students, and parents. The volume was presented to Dr. Caldwell at a luncheon during the meetings of the AAAS in Columbus, Ohio. Two excerpts from these greetings reveal another facet of Dr. Caldwell's personality, so important in all that he did. One was from a parent of the school which he directed:

> And then we sat down and talked to you, and asked you a lot of unintelligent questions, but they were things that were in our hearts and minds. And then we enrolled the first child. And shortly thereafter, the second child, and not so long after that, the third child. And then we made friends with you and the school—you and the school were really one. And in a few years, you built up a magnificent educational institution, you built up traditions, and you made both children and parents happy.

And the other was from Helen Keller:

> We feel twice blest in you as a friend of man and as a scholar who breathes new vitality into many old forms of knowledge.
>
> In you shines truly the spirit of America. It is the American heritage—to think and experiment for oneself, to apply science freely for the benefit of all the people—that teachers like you in the sense of creators arise among us.
>
> Many will honor you for the breadth of your sympathies in quickening young minds and finding constructive solutions for baffling individual problems. With emotion I thank you for the unique tenderness that has moved you to use your immense learning and resources for the blind also. It is a boon to them past computing to have you help them discover their own powers of self-expression and of disciplining their fettered bodies to a creatively shaping will. Affectionately I salute you as a gracious beacon spreading its rays over all the highways and byways of the people's development.

Dr. Caldwell retired from the directorship of the Institute of School Experimentation of Teachers College, Columbia University, at the age of 65. He left behind him the Lincoln School. Those of us who are today still fighting for adequate representation of science in the curriculum can understand why he seized the opportunity of directing a school. The Lincoln School of Teachers College is world famous. Conceived by the Caldwell mind, it lighted a flame which is still burning vigorously in all curriculum laboratories. The Lincoln School placed science at the core of the educative process. Its curriculum determined the physical plant which was built according to the Caldwell blueprint. He gathered a great faculty of broadly educated and competent men and women who became the living examples of a sound program of teacher training. In that school science was much more than a subject to be taught; it was a phase of life to be integrated with all other aspects of child experience.

When Dr. Caldwell retired from his post at Teachers College, he indulged his earliest interest by returning to the work of laboratory scientists at the Boyce Thompson Institute for Plant Research. From that vantage point he carried on as general secretary of the AAAS, where his matured philosophy of science education found new outlets and widened scope.

Science was a way of life to Dr. Caldwell. He could not and would not tolerate prejudiced thinking. What, then, should be done to rid the world of such thinking? The typical Caldwellian answer can be found in his two widely read books: *Science remaking the world* and *Do you believe it?* In the first, he asks that "intellectual and moral ideas shall develop in harmony with modern science." In the second, he subjects man's common superstitions to the cold, blazing light of scientific reason.

"Ignorance and superstition," says Caldwell, "contribute to one another. Knowledge is the enemy of both. In childhood, as with older people, the attitude of desiring knowledge is in itself like an insurance policy that has been secured against superstition. But like any other insurance policy, it is a protection against the event when encountered and not a guarantee that the event cannot occur. Those who fear ignorance but have no fear of truth, need have no fear of superstition. Facts properly interpreted and used make freedom possible. The text that is frequently used about truth making people free is not yet in danger of excessive application."

Trained as a botanist, he knew well the part that biological sciences can play in the education of children. He knew, too, that the essence of this contribution is to be found in all the sciences. With true vision he threw himself into the General Science movement, bringing it to fruition in the schools of the Nation. His textbooks have been and are still being read by millions of school children all over the world, as are also his textbooks in biology.

In 1920 Dr. Caldwell, as chairman of the Committee on Science of the Commission on the Reorganization of Secondary Education, crystallized the pattern of the science curriculum. In this report, science teachers could see clearly for the first time, a sequence of science studies that gave dignity and scope to their efforts. It was Dr. Caldwell again who showed the way in extrapolating that sequence to include the elementary school at one end and the junior college at the other.

We have now followed the trail which Caldwell blazed half way toward its beginning. In 1919 he electrified the science teaching world with his survey of Science Teaching in the Gary Public Schools. In 1917 he had left his post at The University of Chicago, where he had been associate professor, then professor of botany, and finally in charge of science teaching at the School of Education. He had come to the University in 1907 from the Eastern Illinois State Teachers College, where he had held the post of head of the Department of Biology since 1899. From 1897 to 1899 he had been assistant in botany at The University of Chicago, which granted him a Ph.D. degree in 1898. His undergraduate work was done in Franklin College, from which he received the B.S. degree in 1894. Later, in 1917, his alma mater bestowed upon him the degree of LL.D. Otis Caldwell was born on December 18, 1869, in Lebanon, Indiana, where he spent his early youth.

Edwin G. Conklin, renowned biologist and past president of the AAAS, once wrote to Dr. Caldwell as follows:

> Any man who has lived for more than seventy years amidst all the dangers and vicissitudes of life is a biological triumph of adaptation, endurance and good fortune. When in addition he has lived a life of marked intellectual and social leadership and has left his mark not only on his generation but also on future ones, he is one of the immortals.

MORRIS MEISTER, *Principal*

The Bronx High School of Science

NEWS *and Notes*

A Memorial Service for Otis W. Caldwell, whose obituary appears in this issue, was held at the Church of the Redeemer, Yonkers, New York, on Sunday, December 7, at 4:00 P. M. Those participating in the service included Barclay Acheson, Kirtley F. Mather, Morris Meister, H. Otheman Smith, J. Wayne Wrightstone, and P. W. Zimmerman.

With regard to Dr. Caldwell's passing, the Executive Committee of the Association has made the following statement:

> In the sudden death of Dr. Otis W. Caldwell on July 5, 1947, the Executive Committee of the American Association for the Advancement of Science lost its member of longest service, and a colleague who had been a member of the Association continuously since 1900, a Fellow since 1902, and a life member since 1923. Very few persons have been members of the Association longer than Dr. Caldwell, and probably none has as thorough a knowledge of its hopes, plans, and operations as he had. He was vice-president of the Association for the Section on Education in 1925, General Secretary from 1935 until his death, and the principal connecting link between the Association's administrative officers and the 37 affiliated academies of science.
>
> The Executive Committee shares the grief of Mrs. Caldwell and of other members of Dr. Caldwell's family at his passing, and will long cherish his memory as one of the foremost of the loyal men who have made of the Association a great factor in the advancement of science. And even after his many friends and associates shall have passed, the expanding effects of his devotion to the high purposes of the Association will still be felt.

George A. Baitsell, Osborn Zoological Laboratory, Yale University, has recently been appointed Colgate professor of biology and executive officer.

Edward C. Miller, formerly assistant professor of metallurgical engineering, Purdue University, has been appointed associate professor of chemical and metallurgical engineering, Wayne University College of Engineering.

Henry F. Donner, chairman, Department of Geology and Geography, and professor of astronomy, Western Reserve University, will be granted a leave of absence, beginning in February, to drive, with his wife, from the northern coast of Africa to the Lamont-Hussey Observatory in Bloemfontein in Orange Free State. On the way down, they will inspect various volcanoes, mountains, and particularly the Rift Valleys, where some geologists believe the continent is breaking in two. They will also visit the mountain Thaba 'Nchu, in South Africa, which is believed to have broken away from the Malute Range in Basutoland ages ago.

On his first visit to Africa in 1928–33, Prof. Donner made a series of measurements of more than 1,100 binary stars which he had discovered in the southern constellations. On the coming trip, Prof. Donner expects to use the Observatory's 27-inch refractor to determine how far each star in the binary pairs he discovered has moved since 1933. He hopes to make another series of observations in 15 years in order to complete a final report which will provide information about the sizes and masses of the stars.

Lincoln Constance, professor of botany and curator, Seed Plant Collections, University of California, is spending the academic year as visiting lecturer of botany, Harvard University. Until July 1, Prof. Constance is serving as acting director, and **Robert C. Foster** as acting curator, of the Gray Herbarium.

Wellington D. Jones, professor emeritus, University of Chicago, recently spent two weeks with the Department of Geography at Syracuse University. His principal talks centered around the subject of "What Geographers Need to Know About Soils and Associated Land Use."

Orville L. Gilpin, paleontological technician, Chicago Natural History Museum, has been appointed chief preparator of fossils in the Department of Geology.

Arthur David Howard, U. S. Geological Survey, has been appointed associate professor of mineral sciences at Stanford University. Dr. Howard assumes his new duties in January 1948.

Stanley S. Ballard, professor of physics and chairman, Department of Physics, Tufts College, has recently been appointed to the new office of the Secretary for Local Sections of the Optical Society of America for a two-year period.

Arthur Harmount Graves, curator emeritus, Brooklyn Botanic Garden, who is now living in Wallingford, Connecticut, will continue his work on the breeding of disease-resistant chestnut trees and on the nature of disease resistance, under a cooperative agreement with the Connecticut Agricultural Experiment Station. Dr. Graves will also furnish propagative material to the Station. The work is being sponsored also by the Connecticut Geological and Natural History Survey and the Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.

Harry S. Mustard, director, School of Public Health, Columbia University, has recently been made commissioner of public health for New York City.

Visitors to U. S.

Francis Hemming, of London, secretary to the International Commission on Zoological Nomenclature and a well-known entomologist, will arrive in the United States on December 18. Mr. Hemming is coming, at the invitation of the Smithsonian Institution, to promote understanding and cooperation between American zoologists and the International Commission. He will address a meeting in the National Museum auditorium in Washington, D. C., on the evening of December 22 at 8:00 P. M., to which all interested zoologists and paleontologists are invited. He will also address a joint meeting of the several societies of zoologists meeting with the AAAS in Chicago at 3:30 P. M. in the Upper Tower Room of the Stevens Hotel on December 29 and a joint meeting of the Paleontological Society and Society of Vertebrate Paleontology at the Chateau Laurier, Ottawa, on the morning of December 31. Mr. Hemming is anxious to meet and confer with zoologists or groups of geologists at Washington, Chicago, Ottawa, and perhaps other points. He will be accompanied by his wife, Mrs. Margaret F. W. Hemming, who is his personal secretary.

T. A. Stephenson, professor of zoology, University of Wales, and author of a comprehensive monograph on the British sea anemones, has been visiting American laboratories, accompanied by his wife, to gather information on marine ecology. Dr. Stephenson is currently holding an appointment as visiting professor of zoology at the Scripps Institution of Oceanography (University of California), La Jolla.

Grants and Awards

The Council of the Royal Society, England, has awarded Royal Medals to **C. N. Hinshelwood** and **F. M. Burnet.** Prof. Hinshelwood received the award in recognition of his distinguished work on the mechanism of chemical reactions from the simplest gas phase processes to the complexities of cell division; Dr. Burnet, for his distinguished work on bacteriophages, viruses, and immunity, and for his contributions to the study of infectious disease as an ecological phenomenon.

The following awards of medals have also been made by the President and Council of the Royal Society: the Copley Medal, to **G. H. Hardy** for his outstanding part in the development of mathematical analysis in England during the last 30 years; the Davy Medal, to **Linus C. Pauling** for his distinguished contributions to the theory of valency and for their application to systems of biological importance; the Buchanan Medal, to **Sir Edward Mellanby,** for his distinguished researches on the physiology of nutrition, especially in relation to the causation of deficiency diseases; and the Hughes Medal, to **J. F. Joliot** for his distinguished contributions to nuclear physics, particularly the discovery of artificial radioactivity and of neutron emission in the fission process. Dr. Pauling, head, Division of Chemistry, California Institute of Technology, was unable to receive the medal in person December 1, but will soon leave for England, where he will be Eastman professor at Oxford University for the second and third terms.

Clarence W. Balke, Fansteel Corporation, and formerly professor, University of Illinois, has been awarded the 1948 Perkin Medal of the American Section of the Society of Chemical Industry. Dr. Balke, who will receive the medal at a dinner in New York on January 9, is honored for his research in chemistry and metallurgy which led to the development of processes for the production and commercial utilization of tantalum and its sister element, columbium.

Chester G. Fisher, president, Fisher Scientific Company, Pittsburgh, and of Eimer & Amend, New York, will receive the 1947 Pittsburgh Award, a bronze plaque, at a dinner, December 18, at the University Club, Pittsburgh. The award, made annually by the Pittsburgh Section of the American Chemical Society, will be presented "for outstanding contributions to chemistry in the Pittsburgh area." In 1902 Mr. Fisher founded the Fisher Scientific Company, which has grown into one of the Nation's leading suppliers of scientific equipment, apparatus, and laboratory chemicals.

Walter J. Murphy, editor of *Industrial and Engineering Chemistry* and *Chemical and Engineering News,* publications of the American Chemical Society, recently received the honorary D.Sc. degree from Centre College.

Niels Bohr, Nobel Prize winner in physics, has been awarded the Order of the Elephant, highest decoration in Denmark. A dispatch from Science Service indicates that this decoration is one of the oldest in the world, dating back to 1458. Dr. Bohr is the second Danish commoner to receive it during the present century.

Lawrence K. Frank, director, Caroline Zachry Institute of Human Development, New York, and **Catherine Mackenzie,** parent-child editor, *New York Times,* received jointly the fourth annual $1,000 Lasker Award of the National Committee for Mental Hygiene at its 38th annual luncheon, November 13, at the Pennsylvania Hotel, New York. The award was given this year for "contributions to popular adult education in mental health, especially concerning parent-child relationships."

Paul Niggli, Zurich, Switzerland, will be awarded the Roebling Medal of the Mineralogical Society of America at its annual meeting in Ottawa, Canada, December 29–31. Prof. Niggli, who plans to lecture at several universities in this country during January, is the second person from another country to receive this honor, the highest that American mineralogy has to offer for outstanding achievement in its science.

The School of Veterinary Medicine, University of Pennsylvania, has received a grant of $75,000, in amounts of $25,000 per year for three years, from the Grayson Foundation, Inc., for the study of equine infectious anemia. The grant will be used to further research in the development of improved methods of diagnosis, prevention, and treatment of the disease.

Fellowships

Antioch College, Yellow Springs, Ohio, has announced the establishment of a fellowship for research in problems of land use, available to an outstanding graduate in the field of forestry, agriculture, wildlife management, or conservation education. The fellowship is financed by the Hugh Taylor Birch endowment, and the research will be concerned with the development of Glen Helen, a 920-acre tract given by Mr. Birch to Antioch College. Inquiries should be addressed to Kenneth W. Hunt, director of Glen Helen.

The Graduate School of Ohio State University has announced the availability of several scholarships and fellowships for the year 1948–49. The Elizabeth Clay Howald Scholarship, with an annual stipend of $3,000, will be given to a person who has shown marked ability in some field of study and has in progress work, the results of which promise to constitute important additions to our knowledge. Two Muellhaupt Scholarships in Biology, with annual stipends of $1,800 to $3,000 each, are offered to the candidates who are considered most likely to promote, by original research, one of the biological sciences, particularly botany, bacteriology, physiology, and zoology. Candidates must have completed requirements for the Ph.D. degree or its equivalent. Postdoctoral fellowships and scholarships for study in a variety of fields are also available, their stipends ranging from $1,800 to $3,000 for a year, generally beginning July 1. Applications for all those mentioned must be filed with the Dean of the Graduate School by April 1.

Also available to graduate students are

several University Fellowships and Scholarships, with stipends ranging from $400 to $900, and several special endowed Fellowships with stipends ranging from $450 to $1,000. In addition, all fees are remitted except matriculation and graduation fees. University Fellows and Scholars are selected on the basis of merit, irrespective of field, while Special Fellows are for designated fields, but selections within this field are based on merit.

Ethyl Corporation has awarded 9 graduate fellowships in the fields of petroleum, automotive, and chemical research, which provide students with scholarship grants plus tuition. Thus far this year, the fellowships have been created at the University of Michigan (two), Princeton University, University of Tulsa, Wayne University, University of Oklahoma, Louisiana State University, Purdue University, and the University of Texas. A postdoctoral fellowship, the first of its kind offered by the company, has been established at the University of Cincinnati, for study under Robert A. Kehoe, director of the Kettering Laboratory and medical director of Ethyl Corporation. The fellowship program was established 10 years ago to stimulate and aid students who show promise in advanced industrial and engineering research. Recipients are not obligated to work for the company upon completion of their academic work, nor are they restricted as to their courses of study, except that the academic projects be related to the petroleum, automotive, or chemical industry.

Colleges and Universities

The Department of Biology, Johns Hopkins University, has added the following men to its staff: **Francis T. Haxo,** Hopkins Marine Station of Stanford University, as instructor in plant physiology; **V. G. Dethier,** formerly of the Department of Zoology and Entomology, Ohio State University, as associate professor to work in the field of sensory physiology of insects; and **H. Bentley Glass,** geneticist, formerly of Goucher College, as associate professor of biology.

The University of Delaware is offering a new extramural course this year in "Application of Statistical Methods to Design of Experiments and Analysis of Data." This course, a relatively new approach to industrial experiment work, is being offered because a definite need has been evidenced in application of statistical methods to industrial experiments. In charge of the course is **George E. Hulse,** head of scouting research, Hercules Powder Company. Dr. Hulse will be assisted by **Donald S. Villars,** head, Science Department, Jersey City Junior College, who will give 10 of the 14 lectures; **John A. Zapp, Jr.,** Research Department, Haskell Foundation, E. I. du Pont de Nemours and Company; **Vernon Lewis,** also of Du Pont: and **W. L. Gore,** research chemist in plastics at Du Pont's Arlington, New Jersey, Laboratory.

Union College, Schenectady, New York, will expand its facilities for studying child behavior by constructing a new wing to the present psychology building. The addition will include a child observation room, with extensive sound and visual equipment, to add to the facilities for the scientific recording of the behavior of children, and new classroom and office space. The new wing is made possible by an anonymous gift.

Rensselaer Polytechnic Institute is now equipping a new nuclear chemistry laboratory to augment its nuclear science and engineering program, which will be opened to students of the Graduate School in February. The laboratory will provide facilities for training and research in connection with the course in nuclear chemistry inaugurated by the Institute in September. **H. M. Clark,** assistant professor of physical chemistry, who spent last year at the Clinton Laboratories, Oak Ridge, directs the course.

The Technological Institute of Northwestern University has opened a new laboratory for the teaching of catalytic and high-pressure processes in chemistry, which is named in honor of Vladimir N. Ipatieff. The laboratory was officially opened November 22, on the 80th birthday of Dr. Ipatieff. The principal speaker for the occasion was Robert E. Wilson, chairman of the Board, Standard Oil Company of Indiana. Other speakers included Kenneth M. Watson, professor of chemical engineering, University of Wisconsin; Robert K. Summerbell, chairman, Department of Chemistry, and Virgil C. Williams, chairman, Chemical Engineering Department, both of Northwestern University; and Ovid W. Eshbach, dean, Technological Institute. After the program and tours of the laboratory, a private luncheon honoring Dr. Ipatieff was held in the dining hall of the Northwestern University Apartments. Brief congratulatory talks were made by Franklyn B. Snyder, president, Northwestern University; Edwin F. Nelson, vice-president, Universal Oil Products Company; and Ward V. Evans, professor emeritus of chemistry at Northwestern.

"Spinning discs" are being used to test welds and steels in an interesting research program at Massachusetts Institute of Technology sponsored by the Welding Research Council of the Engineering Foundation and directed by **C. W. MacGregor,** professor of applied Mechanics. In an armor-plated pit 40 inches in diameter and 9 feet deep these steel plates are suspended on a flexible steel drive shaft and rotated in a 30-inch vacuum at speeds up to 35,000 r.p.m. The vacuum serves to prevent generation of heat, and when air is admitted, the whirling may be stopped when desired. Under such high speeds the material flows toward the edges, thickening the discs at the perimeter. According to W. Spraragen, director of the Council, this method, when perfected, will find valuable use in testing materials and welds at extremes of temperature, and the results may ultimately be applied in bridge building, ship building, and wherever steel is used at low temperatures.

Illinois Institute of Technology has launched a $15,000,000 development and expansion program which will transform its Technology Center campus into a functionally planned study and residential area for 10,000 persons, covering the 100 acres from 31st to 35th Streets, and from Michigan Avenue to the New York Central Railroad tracks. The architecture was created by Ludwig Mies van der Rohe, chairman of the Institute's Department of Architecture. Three buildings have already been completed and are in use: a Metals Research building, a wing of the Engineering Research building, and Alumni Memorial Hall. Now being completed are a Chemistry building and a Metallurgical and Chemical Engineering building. Also under construction are two student dormitories. Fifty-nine additional academic, laboratory, campus, and housing structures will be erected over a five-year period. Included in this giant plan are buildings for Mechanical Engineering, Civil Engineering and Mechanics, Electrical Engineering and Physics, Architecture, an Institute of Gas Technology, and two research laboratories for the Armour Research Foundation. When completed, the Technology Center will be one of the Nation's most modern centers of technological education and research.

Development of an electronic computer for crystal structure analyses, utilizing X-ray diffraction data, is the subject of a two-year research project being carried on by the Auburn Research Foundation in collaboration with the Department of Physics, Alabama Polytechnic Institute, under contract with the Office of Naval Research. The computer, devised by **R. Pepinsky,** research professor of physics, sums the two-dimensional Fourier series representing the projection on a lattice plane of electron densities in a crystal unit cell, and presents the summation as a pattern on a cathode-ray tube. Some 850 Fourier terms can be added practically instantaneously by the device, and results of alternations of signs of any number of terms are observable just as rapidly.

A contract with the Foundation for X-ray diffraction studies on piezoelectric crystals has been renewed by the Army Signal Corps. This program is based on a grid-controlled, fine-focus X-ray tube, also developed by Prof. Pepinsky, which can be periodically pulsed in synchronism with an oscillating crystal and at any desired phase with the oscillations, thus providing a diffraction stroboscope.

Industrial Laboratories

At the Eastman Kodak Research Laboratories, David L. McAdam has made a new estimate of the number of separate colors the human eye can distinguish in daylight. Dr. MacAdam estimates that there are about 250 distinguishable colors in the spectrum, plus 10,000 distinguishable tints of spectral colors and 7,000 additional colors, like purple, which do not resemble any spectral colors. He pointed out that 17,000 distinct colors of equal brightness are detectable with a precise optical instrument. To this figure, he has added the fact that when large pieces of colored paper are observed with the naked eye, roughly 50 per cent more colors can be distinguished by the eye than by the finest optical means. Under similar favorable conditions, only about 500 distinct shades of gray, ranging from black to white, can be detected. When color is introduced, each shade of gray in the middle range of the scale of about 500 shades between black and white is expanded up to 17,000 times. This means that in the current change-over from black-and-white to color photography, Kodak researchers working for superior reproduction of color in pictures must contend with an increase of from 500 to several million distinguishable differences.

S. B. Penick & Company, in furtherance of its policy of providing the widest possible line of basic materials for the pharmaceutical, wholesale drug, and allied industries in this country and in the export field, has completed arrangements to acquire the New York Quinine & Chemical Works, Inc., which was established in 1885 and manufactures and distributes a broad line of medicinal raw materials. Its headquarters and manufacturing plants are maintained in Brooklyn, and a branch house is located in St. Louis, Missouri. S. B. Penick & Company's present plans call for continuation of the New York Quinine & Chemical Works' business along its established lines.

Interchemical Corporation, through its Biochemical Division, has renewed its annual grant of $25,000 to the Hektoen Institute for Medical Research, Cook County Hospital, Chicago. This grant is for the support of research concerned with intravenous amino acid therapy and with the role of individual amino acids in human metabolism. One of the main objectives of the research program to be pursued is the formulation of an amino acid mixture to be given by vein that will best satisfy physiologic requirements for nitrogen balance.

Robert S. Long, assistant chief chemist, Organic Section, Research Department, Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, has been appointed assistant director of the Organic Section.

Arthur P. Tanberg, from 1921 to 1946 director of the Du Pont Experimental Station in charge of the Chemical Department laboratories and general service facilities of the Station, and since 1946 administrative director of the Department, retired at the end of November. Dr. Tanberg, who began his career with the company as a stenographer in 1910, is being succeeded by **M. M. Brubaker,** former laboratory director at the Station. At the same time **P. L. Salzberg** will take over Dr. Brubaker's former duties. Both of the latter have been with Du Pont for approximately 20 years.

Meetings

George Washington University and the **Carnegie Institution of Washington** were hosts November 13–15 to a group of theoretical physicists who met to discuss the general subject of gravitation and electromagnetism in relation to the general theory of relativity. This conference was the 10th of a series which started in 1934 and which have been held annually except for war years. The purpose of the conference is to promote thinking on, and discussion of, the unsolved problems in theoretical physics. This year's discussions centered on the difficulties inherent in unified field theories, the size of the universe, the proper interpretation of the red shift, and whether there is a correlation between the rotation of celestial bodies and their magnetic fields. Out-of-town participants included: H. W. Babcock, Mt. Wilson Observatory; Gregory Breit, Yale University; Charles Critchfield, University of Minnesota; Richard Feynman, Cornell University; Leopold Infeld, University of Toronto; H. P. Robertson, California Institute of Technology; M. Schwarzchild and John Wheeler, Princeton University; Julian Schwinger, Harvard University; Edward Teller, University of Chicago; Robert Oppenheimer and Herman Weyl, The Institute for Advanced Study, Princeton, New Jersey.

Those attending the Conference on the Use of Radioactive Isotopes in Agricultural Research December 18–20 at Alabama Polytechnic Institute (*Science*, October 24, p. 390) will witness an interesting demonstration by Ralph T. Overman, senior research chemist at Clinton National Laboratory, of how atomic energy affects plants and animals. A rose with an open flower, a bud, and some leaves will be soaked in a solution of radioactive phosphorus and the radioactivity in various parts of the plant measured. According to Dr. Overman, the bud should be practically the only part to take up the activity. For his animal experiments white rats will be used. With these he will show that radioactive iodine, when injected into the animal, localizes in the neck, and that, following injection of radioactive potassium into the blood of an animal, the potassium finds its way almost exclusively to the red cells. The forthcoming conference represents the first in this country on this topic.

A symposium on "Modern Instrumental Methods of Analysis," sponsored by the Minnesota Section of the American Chemical Society and the Institute of Technology, University of Minnesota, will be held March 22–24, 1948. Further details will be announced when available.

The American Academy of Oral Pathology will hold its second annual meeting February 8 at the Hotel Stevens, Chicago. The speakers will include: Carl Waldron, University of Minnesota; B. O. A. Thomas, Washington University, Seattle; Edward Stafne, Mayo Clinic; Carl A. Schlack, Naval Medical Research Institute; Hamilton B. G. Robinson, Ohio State University; Barnet Levy, Washington University, St. Louis; Irving Glickman, Tufts College Dental School; Henry Goldman, Boston; Lester R. Cahn, Columbia University; Herman Becks, University of California; and Myron Aisenberg, University of Maryland.

The Academy will cooperate with the New England Society of Oral Surgeons and the Seminar of Oral Medicine in sponsoring a new monthly periodical, starting in January and entitled *Journal of Oral Surgery, Oral Medicine, and Oral Pathology*, which will be published by the C. V. Mosby Company, St. Louis, and which will replace the Oral Surgery section of the *American Journal of Orthodontics and Oral Surgery*. Kurt Thoma, president of the Academy, will be editor-in-chief and editor for the New England Society of Oral Surgeons; Herman Becks will be editor for the Seminar of Oral Medicine; and Hamilton Robinson will be editor for the Academy.

A Pan-American Engineering Congress will be held in South America late in 1948 or in 1949, and it is hoped that every country in this hemisphere will participate. At a meeting this fall of the Executive Board of the Engineers Joint Council Committee on International Relations, J. S. Thompson, McGraw-Hill Book Company, was appointed to represent the Council at a planning meeting which was held in Lima, Peru, November 28. Participation in the Congress will be recommended to all constituent societies of the Joint Council, including the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers. Canadian engineers will be invited to participate through the Engineering Institute of Canada. Bogota, Colombia, has been suggested as the place for the first Congress.

The Florida Academy of Sciences held its 12th annual meeting at the Florida State University, Tallahassee, November 21–22. Seventy-three papers were presented: 24 in biology, 16 in physics, 8 in bacteriology, 13 in the social sciences, and 12 on general topics. Officers elected for the coming year are: George F. Weber, University of Florida, president; G. G. Parker, U. S. Geological Survey, Miami, vice-president; and C. S. Nielson, Florida State University, secretary-treasurer. Elected as chairmen of the various sections were: John J. Davis, biological; A. A. Bless, physical; and Cyril W. Burke, social. Robert B. Campbell continues as the Academy's representative on the AAAS Council.

The Junior Academy of Sciences held a one-day session in connection with that of the senior group. In addition to presenting 7 papers at their own meeting, members attended a number of the section sessions of the senior academy.

Elections

An International Cancer Research Commission was established as an almost autonomous division of the Union Internationale Contre le Cancer at the Fourth International Cancer Research Congress held in St. Louis, September 2–7. The Commission was set up by unanimous vote of representatives of the 39 nations present. Twenty-one other nations, responding to the invitation transmitted by the U. S. Department of State, expressed great interest, and it is expected that the number of member nations in the Commission will soon be increased. Each nation has only one representative on the Commission, and all representatives have equal voting power. Meetings will be held once a year, never consecutively in the same country. The Commission aims to promote international cooperation in cancer research which is defined as all efforts to advance knowledge of cancer by clinical, experimental, and other means. It does not in any way replace the much larger International Cancer Research Congress which will continue to meet in different parts of the world at intervals of about three years. The following Executive Committee of the Commission was elected, each member having an alternate to act for him if necessary: Ignacio Millan (chairman), Avenida Vera Cruz 69, Mexico, D. F., Alternate, F. Leborgne (Uruguay); E. V. Cowdry (U.S.), Alternate, W. U. Gardner (U. S.); V. R. Khanolkar (India), Alternate, Tu-Shan Yung (China); J. H. Maisin (Belgium), Alternate, A. Lacassagne (France); and A. Haddow (England), Alternate, J. Engelbreth-Holm (Denmark).

At the first annual meeting of the Western Society for Clinical Research held in San Francisco November 7–8 a scientific program was presented and officers elected for the coming year. Mayo Soley, San Francisco, is the new president; Myron Prinzmetal, Los Angeles, vice-president; and Helen Martin, Los Angeles, secretary-treasurer. The Council of the Society consists of Paul Aggeler, San Francisco; Norman David, Portland; Daniel Green, Seattle; Hans Hecht, Salt Lake City; John E. Peterson, Los Angeles; and Lowell Rantz, San Francisco.

NRC News

Fellowships in the Medical Sciences, similar to those which have been administered by the Medical Fellowship Board of the NRC since 1922, will again be available for the year 1948–49. These fellowships, supported by grants from the Rockefeller Foundation, are designed to provide opportunities for training and experience in research in all branches of medical science. They are open to citizens of the United States or Canada who possess an M.D. or a Ph.D. degree and are intended for recent graduates who are not yet professionally established.

In addition to these fellowships, the Medical Fellowship Board administers two groups of research fellowships, made available through a grant from the National Foundation for Infantile Paralysis, Inc. The first group, open to applicants who hold either the Ph.D. or M.D. degree, is intended to provide opportunities for special training and experience in the study of virus diseases. The second group, open only to graduates in medicine who have completed one or more years of hospital experience in clinical surgery and are planning a career in orthopedic surgery, is designed to provide opportunities for training and research in those basic medical sciences which will be of particular value in furthering progress in the field of orthopedic surgery.

A series of fellowships in anesthesiology has been established through a grant from the American Society of Anesthesiologists. These fellowships are offered with a view to fostering a closer union between the clinical practice of anesthesiology and the fundamental disciplines on which anesthesia rests. Applicants must hold the M.D. degree and must have completed one or more years of hospital experience as intern or resident.

The Medical Fellowship Board has also under its jurisdiction a number of fellowships of senior grade in internal medicine (Welch Fellowships), epidemiology, clinical neurology, orthopedic surgery, pediatrics, and virus diseases, for individuals of proven research ability.

Fellows will be appointed at a meeting of the Board early in March 1948. To receive consideration at this meeting, applications must be filed on or before January 1. Appointments may begin on any date determined by the Board.

For further particulars, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

Funds for the Office of Naval Research, created by Public Law 588, signed by the President on August 3, 1946, were appropriated for the pursuit of scientific research having importance to national security. The greater percentage of these funds was designated for the support of basic research in civilian institutions, universities, and industrial laboratories. By the beginning of 1947 over 200 research projects were being supported, some of them being in the Dental Sciences. As more and more dental projects were submitted to ONR, it became evident that a qualified research dentist was necessary as a consultant. The Director of the Medical Sciences Division, ONR, requested such a consultant from the Dental Division, Bureau of Medicine and Surgery, and in February 1946 a naval dental officer qualified in research was ordered, in an additional duty status, to the Medical Sciences Division. On July 7, 1947, a Dental Branch was established within the Division, with this officer acting as head.

A memorandum from the Director of the Medical Sciences Division to the staff assigned 4 per cent of the funds available to the Division to the Dental Branch for the fiscal year 1949. This amount was later revised by the Director to 5 per cent and included the fiscal year 1948.

At present some 14 universities and institutions have submitted proposals for dental research to ONR, and, of these, the following have been recommended for approval: (1) "Dietary and other factors concerned in mouth and tooth deterioration," Cornell University, C. M. McCay, principal investigators; (2) "Use of germ-free animals in the study of dental caries," University of Chicago, J. R. Blayney, director; (3) "Recognition and evaluation of factors influencing microorganisms of the mouth," University of Pennsylvania Dental School, J. L. T. Appleton, principal investigator; (4) "Study of dental casting materials," University of Michigan, Norris O. Taylor, principal investigator; (5) "Hormonal effects on oral hard and soft tissues," Columbia University, E. Ziskin, principal investigator; (6) "Bacteriemias resulting from tooth extraction and scaling," Tufts College, J. P. Lazansky, principal investigator; (7) "Relation of vitamin C in inflammatory conditions of the gingivae," Georgetown University Dental School, W. C. Hess, principal investigator; (8) "Anylotic activity of saliva as related to dental caries," Georgetown University Dental School, W. C. Hess and E. Everett, principal investigators; (9) "Investigation of salivary ammonia and its relation to dental caries and periodontal diseases," Western Reserve University, J. P. Muntz, director; (10) "Influences of dietary protein on dental caries," Massachusetts State College, Julian O. Holmes, principal investigator; (11) "Determination of masticatory efficiency," Tufts College Dental School, J. T. O'Rourke and R. S. Manly, principal investigators.

For further information concerning the dental program communications may be addressed to the Office of Naval Research, Navy Department, Washington, D. C.

In pursuance of the provisions of the "Plenary Powers" Resolution adopted by the International Congress of Zoology at Monaco in March 1913, notice is hereby given that the International Commission on Zoological Nomenclature has received the undermentioned applications for the suspension of the *Règles Internationales* on the ground that their strict application would clearly result in greater confusion than uniformity:

(1) **Class Nematoda:** to validate the use of *Stephanurus* Diesing, 1839 (type *S. dentatus* Diesing, 1839) (188).

(2) **Class Insecta, Order Collembola:** to validate the undermentioned generic names and to designate as types the species noted in parentheses: *Podura* Linnaeus, 1758 (*P. aquatica* Linnaeus, 1758). *Tomocerus* Nicolet, 1842 (*Macrotoma minor* Lubbock, 1862) (199); *Hypogastrura* Bourlet, 1839 (*Achorutes viaticus* Tullberg, 1872); *Noanura* MacGillivray, 1893) (*Achorutes muscorum* Templeton, 1835) (303); *Anurophorus* Nicolet, 1842 (*A. laricis* Nicolet, 1842) (304); *Dicyrtoma* Bourlet, 1842 (*Sminthurus fuscus* Lucas, 1842); *Dicyrtomina* Borner, 1903 (*Podura minuta* Fabricius, 1783) (305).

(3) **Class Insecta, Order Lepidoptera:** to determine the correct specific name of the species commonly known as "*Argynnis adippe*" Linnaeus, 1761 (79); to determine the identity of *Papilio podalirius* Linnaeus, 1758 (183) and *Papilio iris* Linnaeus, 1758 (184); to validate *Papilio aristolochiae* Fabricius, 1775 (186); to suppress the name *Papilio ajax* Linnaeus, 1758 (192); to validate *Porina* Walker, 1856, and to suppress *Porina* d'Orbigny, 1853 (Phylum Mollusca) (194).

(4) **Class Insecta, Order Hemiptera:** to validate *Lachinus* Burmeister, 1839 (type *Aphis roboris* Linnaeus, 1758) and *Cinara* Curtis, 1835 (type *Aphis pini*

Linnaeus, 1758) (174); to validate *Nysius* Dallas, 1852 (type *Lygaeus thymi* Wolff, 1854) (181) and *Fulgora* Linnaeus, 1767 (type *Cicada laternaria* Linnaeus, 1758) (162).

(5) **Class Insecta, Order Coleoptera:** to validate *Rhantus* Stephens, 1835 (type *Colymbetes pulverosus* Stephens, 1838) (171); *Rhina* Latreille [1802–03] (type *Curculio barbirostois* Fabricius, 1775) and *Rhina barbicornis* Latreille, 1804 (202).

(6) **Class Insecta, Order Diptera:** to determine the correct specific trivial name of the "Buffalo Fly" (195); to suppress certain of the generic names proposed by Meigen, 1800, *Nouvelle Classification* (191); to validate *Chlorops* Meigen, 1803 (type *Musca pumilionis* Bjerkander, 1778) (197); *Calliphora* Robineau-Desboidy, 1830 (type *Musca vomitoria* Linnaeus, 1758) (201); and, if necessary, the emendation to *Phlebotomus* of Flebotomus Rondani, 1840 (169).

(7) **Phylum Protozoa:** to determine the relation between *Endamaeba* and *Entamoeba* (reference Opinion 99) (185).

(8) **Phylum Mollusca:** to validate *Aplysia* Linnaeus, 1767 (type *A. depilans* Linnaeus, 1767) and *Tethys* Linnaeus, 1767 (type *T. leporina* Linnaeus, 1767) (22); to designate *Venus verrucosa* Linnaeus, 1758 as the type of *Venus* Linnaeus, 1758 (189) and *Bulla ampulla* Linnaeus, 1758 as the type of *Bulla* Linnaeus, 1758 (190).

(9) **Class Bryozoa:** to validate *Fenestella* Lonsdale, 1839 (type *F. fenestella* Lonsdale, 1839) (154).

(10) **Class Echinoidea:** to validate the use of *Echinocyamus* van Phelsum, 1774 and *Fibularia* Lamarck, 1816 (prior to Lambert 1891) (318); to designate as types of the following genera the species noted in parentheses: *Spatangus* Gray, 1825 (*S. purpureus* Müller, 1788); *Ova* Gray, 1825 (*S. canaliferus* Lamarck 1826); *Echinocardium* Gray, 1825 (*E. cordatus* Pennant, 1777); *Schisaster* L. Agassiz 1836 (*S. studeri* L. Agassiz, 1843); *Moira* A. Agassiz, 1872 (*Spatangus atropes* Lamarck, 1816); and *Brissus* Gray, 1825 (*Spatangus brissus var unie coloreske*, 1778) (317); also *Phyllacanthus* Brandt, 1835 (*P. dubius* Brandt, 1835) and *Strongylocentrotus* Brandt, 1835 (*Echinus drøbachiensis* O. Fr. Müller, 1776) (319); to validate *Archaeocidaris* M'Coy, 1844 (type *Cidaris Urii* Flemming, 1828) (320).

(11) **Class Bivalvia:** to designate *Mytilus edulis* Linnaeus, 1758 as the type of *Mytilus* Linnaeus, 1758 (193).

(12) **Class Gastropoda:** to fix *Pleurocera acuta* Rafinesque, 1831 as the type of *Pleurocera* Rafinesque, 1818 (83).

(13) **Class Pisces:** to validate *Echeneis* Linnaeus, 1758 (type *E. naucrates* Linnaeus, 1758) (156).

(14) **Class Aves:** to determine the type of *Colymbus* Linnaeus, 1758 (78).

(15) **Suppression of books:** to suppress Zimmermann 1777, *Zoologiae geographiacae* for nomenclatorial purposes (182); to suppress the new names of birds and mammals in the recently discovered pamphlet known as the "Hildesheim List," published about 1840 (196).

Zoologists wishing to comment on any of the above applications are particularly requested, when communicating with the Commission, to quote the file number which appears in parentheses at the end of each entry in the foregoing list. Full particulars in regard to all the above items will be published in the *Bulletin of Zoological Nomenclature*. All communications in regard to the above cases should be addressed to the Secretary to the International Commission on Zoological Nomenclature, Francis Hemming, 83 Fellows Road (Garden Flat), London, N.W. 3, England.

A new British journal of science called *Research* appeared in October and will be issued monthly at a subscription rate of $10 per year. The Scientific Advisory Board is headed by Sir John Anderson and includes as members: Sir Wallace Akers, director of research, I. C. I., and formerly director of atomic energy research, Department of Scientific and Industrial Research; Sir Charles Darwin, director, National Physical Laboratory, Department of Scientific and Industrial Research; Sir Alfred Egerton, professor of chemical technology, Imperial College of Science and Technology; Sir Alexander Fleming, professor of bacteriology, University of London; R. S. Hutton (secretary), formerly professor of metallurgy, University of Cambridge; and Sir Edward Salisbury, director of Royal Botanic Gardens, Kew. Paul Rosbaud is editor, and D. R. Rexworthy is deputy editor. The journal covers the wide field of general scientific research and the application of that research work in the general development of industry. The journal was suggested by a group of British scientists to help fill the gap left by the postwar lack of German scientific publications. The American agent for *Research* is Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, New York.

A Metropolitan Long Island Group of the New York Section of the American Chemical Society, comprising chemists and chemical engineers of Brooklyn, Queens, and Long Island, has recently been established. The group was originally organized in 1945 as the Metropolitan Long Island Chemical Association to meet a need created by the area's rapidly growing importance as a center of chemical industry and chemical education. Officers elected for the group are: Harold A. Horan, St. John's University, chairman; Joseph Mattiello, Hilo Varnish Corporation, chairman-elect; Walter I. Smith, New York Quinine & Chemical Works, treasurer; and Emmet S. Carmichael, Socony-Vacuum Oil Company, secretary. Named to the Board of Directors were: R. B. Killingsworth, Socony-Vacuum Oil Company; Samuel W. Gordon, Endo Products, Inc.; A. J. Nydick, patent attorney; and Bernard L. Oser, Food Research Laboratories, Inc.

The British Medical Association has appointed Grune & Stratton, Inc., Medical Publishers, 381 Fourth Avenue, New York 16, New York, as sole U. S. agents for all the Association's periodical publications. The journals include: *British Medical Journal*, published weekly, $14 per year; *Abstracts of World Medicine*, published monthly, $13 per year, and *Abstracts of World Surgery, Obstetrics and Gynecology*, published monthly, $9 per year. Quarterly journals, with uniform subscription rates of $5.50 per year, are: *Annals of the Rheumatic Diseases*; *Archives of Disease in Childhood*; *British Heart Journal*; *British Journal of Industrial Medicine*; *British Journal of Pharmacology and Chemotherapy*; *British Journal of Social Medicine*; *British Journal of Venereal Diseases*; *Journal of Clinical Pathology*; *Journal of Neurology, Neurosurgery, and Psychiatry*; and *Thorax*.

A significant collection of prehistoric sea shells, now at the American Museum of Natural History, was recently uncovered during a three-month expedition to the Peruvian Andes sponsored jointly by the Museum and Columbia

University and directed by **Norman D. Newell**, professor of geology, Columbia University, and curator of Historical Geology and Fossil Invertebrates at the Museum. The purpose of the expedition was to gain information concerning the geologic formations buried deep under the Amazon jungles. Because the same strata underlying the nearly impenetrable jungles come to the surface in the Andes, where it is possible to examine and evaluate oil-bearing types of rock, the expedition centered on the Andes mountain tops between the elevations of 10,000 and 16,000 feet. The discovery of the colorful marine fossils, between 200,000,000 and 300,000,000 years old, adds proof that this mountain range once lay under a shallow sea—probably the same sea that covered Texas and Oklahoma. The research of the expedition will greatly contribute to the knowledge of one of the world's last great untapped oil reserves in the Upper Amazon Basin.

Interest in the formation of a Public Health Biology Section of the American Public Health Association has been expressed by individuals whose major fields of interest and activity involve the application of biological knowledge and technique to public health practice. These fields include medical or public health entomology, parasitology, mammalogy, limnology, ichthyology, malacology, herpetology, mycology, allergenic botany, and doubtless other related specialties. Existing Association Sections—mainly Laboratory, Epidemiology, and Engineering—provide proper affiliation for certain of the APHA biologists, and it is not proposed that any of these currently satisfactory relations be disturbed. Other biologists with investigational or operational concerns find themselves in the Unaffiliated Section for lack of an Association category indicative of their professional interest. It is believed that some public health biologists have failed to join the American Public Health Association because there appears to be no specific place for them within the existing compartmentalization of the society.

A petition for the formation of such a Section in the Southern Branch of the APHA has already been sent to the Governing Council of that organization. It seems desirable, however, to measure interest in the activation of a comparable Section on a national basis to provide the opportunity at the annual meetings of the APHA for the presentation of more detailed papers and technical discussion of mutual problems in public health biology than might be undertaken in the general sessions of the Association.

As a preliminary step in this direction, it is requested that those interested in the formation of a Public Health Biology Section in the APHA indicate their approval of such a plan and their willingness to cooperate in its activation by writing to Justin M. Andrews, Communicable Disease Center, U. S. Public Health Service, Atlanta, Georgia.

A series of river basin surveys in areas soon to be flooded by the building of dams is currently being undertaken by the Smithsonian Institution in cooperation with the Bureau of Reclamation, National Park Service, and the Corps of Engineers, U. S. Army. Director of the entire project is Frank H. H. Roberts, Jr., associate chief of the Institution's Bureau of American Ethnology.

This past summer more than 500 archaeological sites were found in the Missouri basin alone. These contained evidence of Indian villages, forts, burial mounds, etc. Most productive from the archaeological standpoint were the Fort Randall Reservoir area in South Dakota, where 93 such sites were recorded; the Garrison Reservoir area in North Dakota, in which 55 individual sites were recorded; and areas in Wyoming and Montana, location of some 200 sites. Waldo R. Wedel, of the U. S. National Museum, who was in charge of the field work, indicates in his report that the South Dakota sites cover a period of at least 1,000 years of human occupancy, while some of those in North Dakota were inhabited before the pottery art was acquired by the Indians. From several of the sites in Wyoming and Montana have come artifacts of the so-called Yuma period, which may have flourished as much as 10,000 years ago.

In the Columbia River basin 120 sites have been found. According to Phillip Drucker, of the Bureau of American Ethnology, who was in charge of surveys in that area, this basin is little known archaeologically. Apparently some of the sites were fishing bivouacs used year after year by the Indians, as evidenced by a succession of deposits of camp debris. Caps of volcanic ash indicate great antiquity, possibly dating back to the closing days of the last ice age.

An attempt will be made to excavate some of the most promising sites in all these areas before flooding makes further work impossible.

The National Registry of Rare Chemicals, 35 West 33rd Street, Chicago, lists the following wanted chemicals: cyclohexadiene monoxide; pregnene-4-triol-17(B),-20-(B)-21-dione-3,11-monoacetate-21; pregnene-4-triol-17(B),-20-(B)-21-dione-3,11-diacetate-20,21; pregnene-4-diol-17,20-one-3-al-21; 17-hydroxy-11-desoxycorticosterone; 3-(α)-acetoxy-11-keto-20-aminopregnane; maltobionic acid; 2-propenylpyridine; 3-methylfuran, 2,4-furandicarboxylic acid; stigmasterol; 1-tartaric acid; strontium tetrasulfide hexahydrate; 5-chloropentene-1; 6-chlorohexene-1; 7-chloroheptene-1; embden ester; cyclooctadiene-1,5; cyclobutadibenzene; anthrafurane; benzoxanthene; and coniferin.

The archaeological and paleontological collections of Cyrus N. Ray, president, Texas Archaeological and Paleontological Society, made in Texas during the past 20 years, have been transferred to the ownership of the Museum at Texas Technological College, Lubbock. This collection includes a large number of old Texas human crania and vertebrate and other fossils, in addition to 16,000 stone artifacts, belonging to all Texan prehistorical periods as far back as the Folsom, Clear Fork, and Abilene cultures. This is the largest collection of the Clear Fork Culture in existence, and is the original and the type collection of a culture which was used in the Abilene, Texas, region during about the same period as that of Folsom man.

Make Plans for—

American Astronomical Society, December 28–31, Ohio State University, Columbus.

American Anthropological Association, December 28–31, University of New Mexico, Albuquerque.

American Mathematical Society, December 29–31, University of Georgia, Athens.

Archaeological Institute of America, December 29–31, New Haven, Connecticut.

Geological Society of America, December 29–31, Chateau Laurier, Ottawa, Canada.

TECHNICAL PAPERS

Variants of *Escherichia coli, Pseudomonas aeruginosa*, and *Bacillus subtilis* Requiring Streptomycin

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Recently, Miller and Bohnhoff (*2*) reported the isolation of a meningococcus variant which required streptomycin for reproduction *in vivo* and *in vitro*. This variant, called type B, appeared in maximum numbers when streptomycin was present in the medium in concentrations of 60–1,000 µg./ml. It produced a small, pearly-gray colony in the presence of low concentrations (60–100 µg./ml.) of the antibiotic, and a large, slightly yellowish colony with higher concentrations, as compared to the large, yellowish colony of the nonrequiring resistant strain, or type A.

We have recently made a similar observation in our laboratory. Strains of *E. coli*, *Ps. aeruginosa*, and *B. subtilis* that had developed resistance to streptomycin when grown on synthetic media yielded better and more rapid growth in the presence of the antibiotic. The variant strains had developed a resistance to 1,000, 8,000, and 1,000 µg./ml. of streptomycin, respectively, while growing on synthetic media.

A variant of *B. subtilis* was isolated which, on nutrient agar plates containing 150 and 300 µg./ml. of streptomycin, produced a grayish-translucent, spreading growth. This strain, which consisted of granular, rod-shaped organisms, grew only when streptomycin was present in the medium and only under anaerobic conditions. In addition, a small number of streptomycin-resistant organisms similar to the type A meningococcus reported above were noted. These produced a flat, grayish-white, spreading colony and were aerobic, nongranular rods.

The basal synthetic medium used in this work was similar to the one devised by Grossowicz (*1*) except for the exclusion of glucose, sodium thiosulfate, sodium d-glutamate, and thiamine. This basal medium contained only NH_4Cl as a nitrogen source and excluded all carbon-containing compounds, and these organisms could not grow until carbon compounds such as those indicated in Table 1 were added to the basal medium. Growth, which was measured by use of the Evelyn Photoelectric Colorimeter, was thus dependent upon the utilization of these added substances.

As indicated in the table, streptomycin stimulated the growth of all the organisms when glucose was present in the medium. Under similar conditions, only *Ps. aeruginosa* was stimulated when formate was present.

TABLE 1

Growth of Streptomycin-resistant Strains on Various Media With and Without Streptomycin

1		2			3			4			5		
Medium		B.M. + Na formate			B.M. + glucose			B.M. + glucose + Na d-glutamate			B.M. + glucose + Na d-glutamate NH_4Cl		
Time (hrs.)		24	48	72	24	48	72	24	48	72	24	48	72
Strain	Streptomycin conc.												
E. coli													
Suscept.	0	97	95	96	70	60	52	*			*		
SM	0	91^{3}	91^{1}	91^{2}	78^{2}	58^{3}	52^{2}						
SM	250 µg./ml.	91^{2}	91^{3}	91^{1}	66^{2}	56	52^{1}						
Ps. aeruginosa													
Suscept.	0	92	83	83	91	71	39	*			*		
SM	0	95	84	84	86^{2}	53	30						
SM	500 µg /ml.	74	70	73	73^{2}	43	36						
B. subtilis													
Suscept.	0	100	100	100	98	98	98	94	95	95	100	98^{2}	96^{1}
SM	0	100	100	100	97	97	94	92	94	95	99^{2}	96	93^{2}
SM	300 µg./ml.	97	97	97	75^{2}	85	88	77^{2}	75^{2}	77^{3}	79^{3}	81^{1}	83

Suscept. = susceptible strain; SM = streptomycin-resistant strain; B.M. = basal medium. * These organisms were not grown in these media.

The growth of the *B. subtilis* strain in the presence of streptomycin and glucose reached its maximum level within 24 hours. However, when an additional carbon and nitrogen source was provided in the form of sodium d-glutamate, growth of *B. subtilis* was maintained for the entire period of observation at the maximum level it had attained with the glucose alone. The removal of some of the available nitrogen by the elimination of the NH_4Cl caused a slight decrease in that level. There was little or no growth of nonrequiring or susceptible organisms in any of the media used.

These results might be explained on the assumption that the *E. coli* and *Ps. aeruginosa* variants consisted of a mixture of resistant and streptomycin-requiring strains, while the *B. subtilis* streptomycin strain consisted almost completely of a population requiring this antibiotic.

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Seasonal Variation in the Gonadotropic Potency of Dried Anterior Pituitaries of *Rana pipiens*[1]

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It is well known that the injection of anterior lobes of fresh pituitary glands may induce ovulation in a variety of animals. Among amphibia, Rugh (*3*, *4*, *5*) has shown that the gonad-stimulating potency is retained by the gland temporarily when preserved in distilled water and lower concentrations of alcohol, and may be maintained indefinitely when kept in 100 per cent alcohol.

TABLE 1

Comparative Doses for Fresh and Dried Female Anterior Pituitaries Required to Induce at Least 50 Per Cent Ovulation

	November	January	March
Rugh ('41) (fresh glands)	5	4	3
Hamburger ('42) (fresh glands)	5-6	3-5	2-3
Present data (dried glands)	4-7	4	2-3

In order to prevent loss of potency by injection in aqueous solution as well as contamination by traces of alcohol, a simple drying technique was devised by which anterior lobes of glands (*Rana pipiens*) were oven-dried at 94° C. for 48 hours and stored in desiccators until injected. A preliminary experiment conducted on 6 nonbreeding frogs collected in Wisconsin in November demonstrated that as few as 4 dried anterior pituitaries (from female donors) will induce ovulation, although as many as 7 or more may be needed on some frogs. Subsequent tests in January (25 frogs injected) and March (17 frogs injected) showed dried anterior pituitaries to be as effective as fresh glands in inducing ovulation, as determined by both the stripping method and direct observation of the ovaries. The effective doses for dried glands are compared with those given by Rugh (*7*) and Hamburger (*1*) for fresh glands, female donors being used in all cases (Table 1). As far as we are aware, there is no report in the literature concerning either the use of, or the doses necessary for, dried glands to induce ovulation in frogs. Rugh, however, states in a personal communication that the method has been used successfully in his laboratory.

The technique involving injection of dried anterior lobes has been applied to the problem of the determination of the relative gonadotropic potency of pituitary glands compared with the relative responsiveness of the gonad during various seasons of the year. The work of Rugh (*4*, *5*, *6*) indicates that the pituitary of the donor, as well as the gland of the recipient, may undergo seasonal changes. However, the variations in the gonadotropic activity of both are confused by seasonal changes in the responsiveness of the gonad. In some animals clear-cut seasonal changes in gonadotropic potency of the pituitary have been shown, as, for example, in the 13-lined ground squirrel, *Citellus tridecemlineatus*. Moore, *et al.* (*2*) were able to detect no gonad-stimulating hormone in the sexually inactive animals, but they found considerable gonadotropic substances on the approach of the reproductive season.

Glands removed from freshly caught frogs (*R. pipiens*) and dried in mid-January were compared in ovulation-inducing capacity with glands removed and dried in mid-March. The recipients, females in the prebreeding condition, were injected during the last week of March. All recipients, furthermore, were tested for ovulation by stripping and shown to be negative prior to injection. Control frogs did not ovulate throughout the duration of the experiment, terminated the last of April. Whereas an average of 4 January glands were necessary to cause at least 50 per cent ovulation (within one week after injection), 1-3 March glands induced ovulation in frogs in the same stage of breeding activity (Table 2). Although the number of experimental animals used was necessarily small, there is clearly a marked decrease in the number of donor glands required to induce ovulation between January and March. As all injections were made into March frogs, of comparable body length and breeding activity, it seems evident that the seasonal change is to be attributed primarily to ovulation-inducing capacity of the pituitary rather than to a change in the responsiveness of the gonad.

TABLE 2

Ovulation-Inducing Capacity of Dried Female Anterior Pituitaries From January and March Frogs Tested by Response of March Frogs

Gland source by date	No. glands per frog	No. frogs injected	No. showing at least 50% ovulation	% showing at least 50% ovulation
January	2	9	0	0
	3	10	3	30
	4	6	4	66
March	1	6	4	66
	2	6	4	66
	3	5	5	100

From these observations it is concluded that (1) desiccation does not alter the potency of the anterior pituitary, and (2) the gland undergoes seasonal variation increasing in gonadotropic potency between January and March.

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[1] We are indebted to Dr. Roberts Rugh of New York University for suggestions in the preparation of this manuscript.

[2] Now at the University of Illinois, Department of Zoology.

Rate of Disappearance From Plasma of Intravenously Administered Methionine in Patients With Liver Damage[1]

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In a previous paper (*2*) it was reported that following the intravenous administration of 1.5 gram of DL-methionine to normal male subjects, a predictable disappearance of the L isomer occurred over a 2½-hour interval.

It was postulated that protein metabolism in patients with liver disease might be sufficiently impaired to decrease significantly the rate of disappearance of the L isomer from the plasma, and that if such proved to be the case, the rate of removal might be construed as the rate of utilization, *i.e.* anabolism or catabolism, exclusive of diffusion or storage.

The same technics were used in the individuals with liver damage as in the normal controls (*2*). These procedures consisted, in brief, of administering 50 cc. of 3 per cent DL-methionine intravenously over a 5-minute period and then determining the plasma L-methionine values at 0 (fasting, premethionine), 15, 30, 60, 120, and 180 minutes postmethionine.

Microbiologic assays for methionine on both blood and urine were carried out as previously described (*2*), using as a test organism *Leuconostoc mesenteroides* P-60, which detects only the L isomer (*1*). In the majority of cases here reported, assays were simultaneously performed with *Lactobacillus fermenti* 36, which utilizes both D and L isomers (*1*). Urinary methionine was determined on an aliquot of a sample collected over the 12 hours preceding the test, for the 3-hour period during the test, and for the 43 hours after its completion. For the 24-hour period immediately preceding and the 48-hour period following the test, the dietary intake of methionine was maintained at an essentially constant level.

The findings in all controls and in the first 13 patients with liver damage studied are presented in this preliminary report. The rate of disappearance per hour over the 30–180-minute period has been adopted as the index of methionine utilization. All these data, together with other "liver function" values for comparative purposes, are presented in Fig. 1. Study of this graph reveals the following:

(a) With the exception of one high value, the rate of removal in the control subjects varies from 330 to 540 μg./hour with a mean of 410. Additional data obtained since completion of this diagram both in controls and in completely well posthepatitis patients, confirm this range and mean.

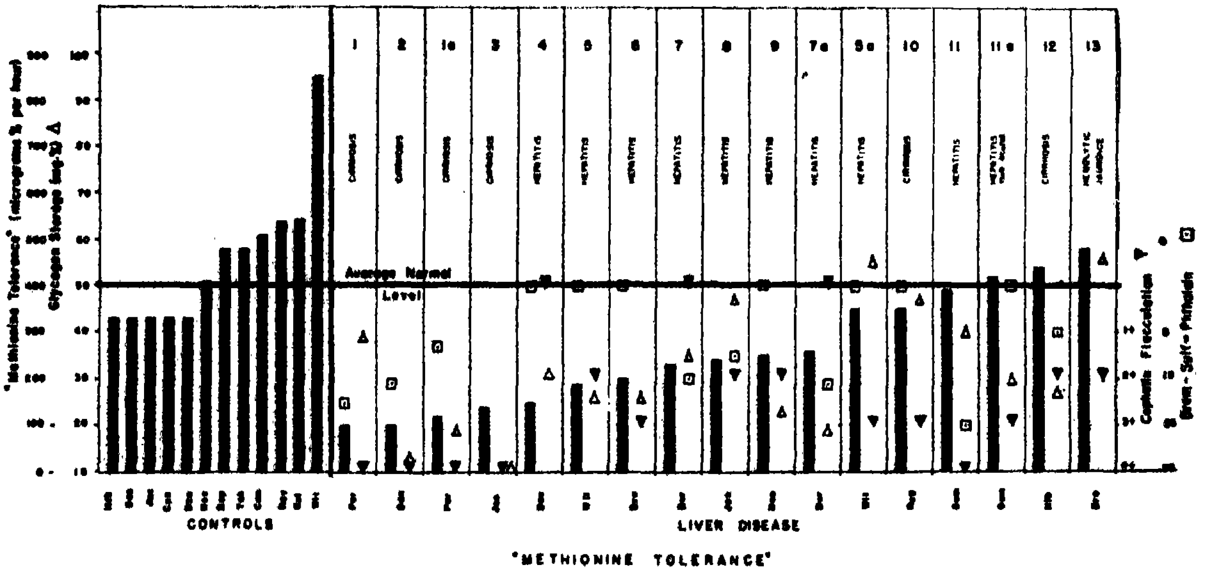

FIG. 1. Columns represent rate of disappearance of plasma methionine in micrograms per cent per hour.
1 and 1a—Values in the same cirrhotic at a 6-week interval—note constancy of all findings. Clinical status unchanged.
7 and 7a—Acute hepatitis patient, 2-week interval; still active hepatitis. A third value obtained 2 weeks later was within normal limits (340 μg./hour)
5 and 5a—Acute hepatitis, 3-week interval—note correlation with glycogen storage index.
11 and 11a—Patient with subacute hepatitis, 12-week interval; considerable fibrosis and round cell infiltration in biopsy specimen.

(b) With rare exceptions, patients with acute or chronic liver damage show a significant decrease in the rate of removal of the administered methionine.

(c) Hepatitis patients progress from abnormal to normal values during convalescence.

The data on urinary excretion of L- and DL-methionine, and on blood levels of D (DL- minus L-)-methionine will be considered in detail in a later paper. On the basis of data so far obtained one may, however, make the following statements:

(a) Urinary excretion of L-methionine in normal individuals and in patients with liver damage is minimal, in no instance exceeding 6 mg. during the 3-hour postinjection period.

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[1] This work has been performed under a grant from the Office of Naval Research.

The methionine used in this study has been supplied through the courtesy of the Wyeth Company.

(b) D-methionine, on the other hand, is excreted rapidly, during and following the intravenous administration of the DL-preparation, up to 35 per cent of the administered dose being excreted during the 3-hour test period. This is of obvious importance in a consideration of the net retention of an administered dose of the DL compound. The blood levels show a higher initial peak than in the case of the natural isomer with a more rapid rate of disappearance, which is at least in part referable to rapid excretion.

It is thus concluded that the rate of removal of intravenously administered L-methionine serves as an index of liver function.

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A Chemical Control of Seedstalk Development in Celery[1]

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Premature seeding, commonly called "bolting," poses as one of the most serious problems in the production of early celery. Cold spring weather, conducive to bolting, frequently follows field transplanting of the early crop. The plants, normally biennial, react as annuals, frequently developing seedstalks the first year if they are repeatedly exposed to temperatures below 50° F. (*2*). Attempts which have only partially overcome the adverse effects of low temperatures include the use of various field protective coverings, the introduction of strains having nonbolting tendencies, and late planting after danger of cold weather has passed—all of which result in either considerable loss or expense to the grower. On the assumption that some chemicals of the plant growth hormone type might have the faculty to affect flowering and subsequent seedstalk development in celery, the following experiment was designed.

Celery (Cornell 19, Stock No. C 6313, Ferry Morse) was sown in the greenhouse January 28, transplanted March 5 into 3-inch clay pots, and held at a minimum night temperature of 60 ± 1° F. On April 4 the potted seedlings, arranged in groups of 20, were sprayed with various concentrations of several growth-regulating substances. Ten treatments and a control were compared. Water sprays of the various chemicals were applied by means of small household sprayers, care being taken to insure complete coverage of all aerial plant parts. Thirty-six hours following spraying, one-half of each group was removed to a cold frame, where the plants were exposed to minimum night temperatures of 41 ± 2° F. The other half remained in the greenhouse at the night temperature of 60° F. On May 26, both lots were transplanted into the open in muck soil as two randomized replications for each of the two temperature treatments. The four blocks were adjacent, and each plot contained 5 plants.

Seedstalk development was evident after one month on control plants which received the cold frame exposure. By July 13, two and one-half weeks later, 80 per cent of the plants had bolted. Seeding was 100 per cent by August 21, and mature seed was present on the same plants September 1. In sharp contrast, celery plants sprayed with 100 ppm of α-o-chlorophenoxypropionic acid (*4*) showed no evidence of seedstalk development throughout the experiment. All plants so treated remained strictly vegetative and attained a marketable size (Fig. 1).

Similarly, seeding on the control celery plants from the warm greenhouse occurred by August 20, and on September 30, 80 per cent had bolted. Again, without exception, those plants which had received the spray of α-o-chlorophenoxypropionic acid, yet otherwise identically treated, remained vegetative.

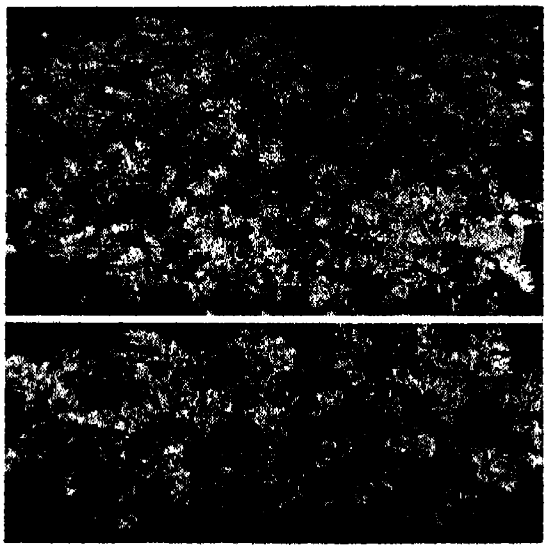

Fig. 1. Prevention of premature seeding of celery by treatment of plants with α-o-chlorophenoxypropionic acid. *Above*: Controls (no treatment). *Below*: Treated plants four months after treatment.

The supposition that organic chemicals having the properties of phytohormones might be introduced into a plant at different stages of growth and affect its development was formulated by Cholodny (*1*). Van Overbeek's recent work (*3*) on the control of flowering in the pineapple supports this concept. It is now a well-known fact that physiological manifestations resulting from the action of growth regulators on plants are dependent on concentration as well as on qualitative differences in the various chemicals. We have assembled evidence demonstrating that, for a given plant, the same substance may accelerate or retard flowering, as the case might be, depending on the concentration used. Our data strongly suggest possibilities in controlling seedstalk development (flowering ?) in certain vegetable crops by applying hormone-like chemicals before the temperature-induction of flowering occurs. A continuance of these studies with the many practical ramifications as objectives should be fruitful in providing a key to some of the causal factors in the flowering process in higher plants.

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[1] Journal Article No. 913 (n.s.) from the Michigan Agricultural Experiment Station.

Is the Action of Calcium in the Coagulation of Blood Stoichiometric or Catalytic?[1]

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By determining the amount of thrombin formed from known quantities of calcium, one is able to conclude whether the action of the latter is catalytic or stoichiometric. A simple method to control accurately the concentration of calcium is to add known amounts to plasma obtained from blood decalcified by passage through Amberlite[2] according to the procedure recently described (*4*). Thrombin may be satisfactorily estimated by allowing a plasma to clot and then (after the thrombin has been inactivated by the normal antithrombin of the plasma) determining the amount of prothrombin remaining.

TABLE 1

Quantitative Relationship Between Prothrombin Activation and the Calcium Concentration in Human Plasma

	Mixture	(cc.)	Clotting time of mixture (sec.)	Prothrombin remaining in serum after 1 hr. incubation	
				Time* (sec.)	Per cent of normal (approximate)
	Amberlite plasma	0.4			
1	Thromboplastin	0.1	90	11	100
	Calcium chloride, 0.0006 M	0.1			
	Amberlite plasma	0.4			
2	Thromboplastin	0.1	13½	35	10
	Calcium chloride, 0.0025 M	0.1			
	Amberlite plasma	0.4			
3	Thromboplastin	0.1	12½	105	2
	Calcium chloride, 0.005 M	0.1			

* To 0.1 cc. of serum were added 0.1 cc. of thromboplastin, 0.1 cc. of 0.02 M calcium chloride, and 0.1 cc. of fibrinogen or fresh human plasma treated with tricalcium phosphate. The preparation of reagents and the general procedure have been described previously (*2*).

The results summarized in Table 1 clearly suggest that the relation of calcium concentration to thrombin production is stoichiometric. When the calcium chloride concentration in plasma is 0.00015 M (Mixture 1) or lower, very little prothrombin is changed to thrombin in one hour, even though other conditions, including an excess of thromboplastin, are optimum. The thrombin formed, although very small in amount, coagulates all the fibrinogen because it acts enzymatically. Were the action of calcium catalytic, it would similarly convert all the prothrombin to thrombin. It is only when the calcium concentration of plasma is 0.0012 M (Mixture 3) that nearly all of the prothrombin is consumed or converted.

These findings supply another link in the chain of evidence that the reaction or reactions that bring about the production of thrombin from the prothrombin complex, thromboplastin and calcium, are chemical and not enzymatic. That thromboplastin acts stoichiometrically was indicated by the work of Mertz, Seegers, and Smith (*1*) and recently confirmed by the writer working with hemophilic blood (*5*).

Calcium is closely associated with prothrombin, but the solution of this relationship is contingent upon a fuller understanding of the composition of prothrombin. The concept of the writer (*3*) that it is a complex and not a unitary substance has recently found clinical confirmation (*6*). The writer has studied one family in which three members have a congenitally reduced concentration of one of the components, designated as "B", and recently he has discovered another family in which two brothers have a congenital lowered level of a second principle, which has been named component A. Much study will be required before one can determine how these factors interact, but from available data it appears fairly certain that the reactions follow the law of mass action, and that none of these factors can be considered accelerators or activators in an enzymatic or catalytic sense.

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[1] This research was supported by a grant from the U. S. Public Health Service.

[2] Amberlite IR 100 is a phenol-formaldehyde resin which functions as a cation exchanger.

The Action of the Endotoxin of *Trypanosoma cruzi* (KR) on Malignant Mouse Tumors[1]

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This communication is essentially a verification of the findings of Roskin and Kluyeva (*2*) in producing the substance designated as KR, an extract of the lysed cells of *T. cruzi*, which has a lytic effect on certain malignant tumors.

A culture of *T. cruzi* was obtained which originated from authentic cases of Chagas' disease.[2] Following the Russian prescription, this was allowed to grow on a sterile medium containing rabbit blood at a temperature of 22–24° C. In a period of 14–19 days large colonies of organisms were obtained.

Only minor changes were made in the original Russian procedures in preparing the extract of the endotoxin. Lysis was accomplished by covering with pyrogen-free distilled water and allowing to stand at refrigerator temperatures overnight. Metaphen at a final concentration of 1:10,000 was used to ensure additional protection against bacterial contamination.

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[1] Presented at the Fourth International Cancer Research Congress, September 2–7, 1947, St. Louis, Missouri.

[2] Grateful acknowledgment is made to J. A. Aeschlimann and R. Schnitzer, of Hoffman-La Roche, Inc., Nutley, New Jersey, and to Malcolm Soule, University of Michigan, for cultures designated as 2 and 3. (When the two cultures were combined in one, the designation is 23. Culture 3 was used in practically all our work, unmixed with 2.)

The lysed material was designated and was rated in terms of the number of lysed organisms per milliliter, as determined by counts before lysing. One KR unit is the lysed product of 1,000,000 organisms.[3]

Careful technique is required in the procedure, because *T. cruzi* is very sensitive to temperature, nutrient base, and other variables. Lysis is easily produced, and any inadvertent departure from set conditions might result in a high mortality of the organisms before the proper separations can be made. In addition, a variation in strain might lead to entirely inactive extracts, as reported by T. Hauschka and associates (*1*).

TABLE 1

Effect of the Endotoxin of *T. cruzi* on Mouse Malignant Tumors
(Series A: Spontaneous Mammary Carcinoma)

Mouse	Dates	KR Prep.	No. of injections	Am't tumor left (%)	Histology of organs
Group 1					
1 k	6/16-6/23	61347-23	8	10	Normal
3 k	"	"	8	25	"
6 k	6/16-6/26	"	10	25	"
7 k	"	"	10	20	"
9 k	6/16-6/23	"	8	5	"
11 k	"	"	8	0	"
4 d 7/14	6/16-7/14	"	18	5	"
5 d 7/2	6/16-7/1	"	13	0	"
Group 2					
13 k	6/23-7/22	613	21	0	"
14 k			23	0	"
15 k			12	0	"
18 k accid.			3	50	"
20 k			18	0	"
19 d 7/2			8	80	Autolyzed
Group 3					
21 k	6/30-7/23	627-3	18	0	Normal
23 k			13	0	"
24 k			4	20	"
28 k			21	0	"
32 k			5	65	"
22 d 7/29	2 tumors		14	0	Autolyzed
26 d 7/30			19	10	"
29 d 7/31			16	5	"
30 d 7/3	Very large		3	95	Necrotic liver
33 d 7/29			19	0	Normal
34 d 7/8			5	65	Fatty yellow liver
Group 4					
36 k	7/15-8/14	7104-3	21	0	Normal
40 k			16	0	"
42 k			16	0	"
45 k			19	0	"
38 d 8/14			23	0	"
41 d 7/31			13	5	Autolyzed
46 d 8/3			12	5	"

d = died, k = killed, 0 = no tumor found.

Two kinds of well-established malignant tumors in mice were tried: (a) spontaneous mammary carcinoma and (b) sarcoma 180. Injections of 1 KR unit were made throughout the experiments, unless otherwise noted, as in the toxicity tests. They were made daily, a day being skipped occasionally, as on Sundays. In some cases the animals were used for assay purposes on materials which proved to be inactive, and consequently the treatment with active material was thus delayed or protracted.

Complete observations were made as to the initial condition of the cancers, effects in the gross during treatment, and effects in the gross and in the histology when animals were autopsied, with special attention to the tumor site, liver, kidney, heart, lungs, etc. Slides were prepared in all cases, unless a particular tissue were autolyzed. Photographic records were taken at frequent intervals.

TABLE 2

Effect of the Endotoxin of *T. cruzi* on Mouse Malignant Tumors
(Series B: Sarcoma 180)

Mouse	Dates	KR Prep.	No. of injections	Am't tumor left (%)	Histology of organs
52 k 8/14	Start 7/15	7247-3	7	0	Normal
54 k 8/14			7	0	"
57 k 8/14			11	0	"
61 k 8/14			9	0	"
49 d 7/24		710-34A	8	100	Autolyzed
50 d 8/14			10	0	"
51 d 8/3			13	10	"

Mice # 53, 56, 59, 63 still alive 8/28/47 with no visible tumors; injections stopped at 10.

Table 1 is a summary of experiments with a selected group of mice having well-developed, proven, spontaneous mammary carcinoma. Table 2 is a summary of experiments with a selected group of mice having well-developed, proven sarcoma 180.

Figs. 1 and 2 show the appearance of a sarcoma at the start and after complete regression followed by a period of recovery and growth, and the histological evidence of regression under treatment to a completely necrotic condition of the cancer.

The spontaneous mammary carcinoma mice came from a strain in constant use in research, on which numerous controls were tested and showed no spontaneous remissions. The tumors form at about 9 months of age and are well-developed 3–4 weeks later, at which stage they were used in the experimental work. In the controls the mortality is nearly 100 per cent in 2 months. The sarcoma 180 mice were chosen at an advanced stage of tumor development, namely, at 2.5 weeks, when the life expectancy shown by numerous controls was 3 weeks. On groups so screened the spontaneous recovery is well below 10 per cent.

Although an effort was made to make all the preparations of KR of the same strength, the biggest factor of uncertainty was the difficulty of making accurate counts of organisms. There must also be hidden variables in the techniques of seeding cultures, small variations in the conditions of growth and harvesting, in the chemical purification, and in the conditions of lysis which affect the potency. That the preparations were not of equal strength is suggested by the fact that the animal responses were not quite proportional to the total dosage. One preparation of KR (Table 1, group 3) showed a high mortality, attributable possibly to inadequate purification.

The character of the regressions can be gauged from the following typical case histories:

Mouse #21: spontaneous mammary carcinoma. Tumor in the left inguinal region, 1 x 1.5 cm. It was firm and infiltrated into the surrounding tissue. Treatment was started on June 30, 1947, and stopped on July 22, a total of 18 injections being given at a uniform dosage of 1 unit/injection. Shrinkage and marked softening of the tumor was apparent after the 4th daily injection; after the 7th injection, only a small nodule could be palpated; after the 12th, no tumor at all could be palpated. The animal was killed and autopsied on August 14. No tumor was found. A 2-mm. nodule consisting of fibrous tissue was present at the original tumor site. All organs were normal under microscopic examination.

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[3] Since the results are due to an active ingredient of the KR, calibration will have to be made in terms of its action on standard tumors. It is suggested that the active ingredient of KR be called *trypanosin*.

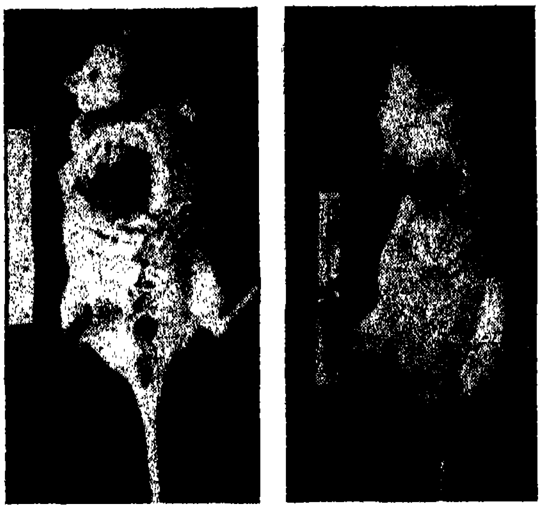

FIG. 1. Regression of sarcoma 180 and recovery thereafter (mouse #54). *Left:* before treatment. *Right:* one month after 7 injections.

FIG. 2. H and E × 90 photomicrograph showing spontaneous mammary carcinoma completely necrotic after 5 injections with KR (some fibroblastic proliferation present).

Mouse 54: sarcoma 180. The initial tumor was 10 days old, 5.5 cm. in diameter, firm, and partly ulcerated. Injections were started on July 15, 1947, a total of 7 being given in the course of a week. After the 4th injection the tumor became smaller, completely ulcerated, and discharged cheesy material; after the 6th, the tumor was 0.25 cm. in diameter; on the 7th, the tumor was entirely gone, and the original site was completely covered with new epithelium. The mouse was kept alive for 3 weeks after healing, during which time it lost its runted appearance and gained weight. It was then killed and autopsied. No tumor was found. Fibrous tissue was found subcutaneously. All organs were normal in the gross and microscopically.

The KR was also probably of unequal stability because the conditions of preservation at low temperatures differed, as did the time of exposure to the air. The Russian observers claim a period of stability no longer than 10 days. If the same KR was used beyond 10 days, *i.e.* beyond injection 9, there is still some doubt whether the preparation was fully active.

It is apparent that with potent preparations of KR (Table 1, group 2) 10 or more injections on consecutive days can produce 100 per cent remission of tumors with no damage to any organs.

Damage to the liver was noted only in the case of 2 mice, both of which died before any extensive treatment with KR, namely, after the 3rd and 5th injections (mice 30 and 34), and both treated with the same preparation, which was considered impure. Mouse 30 had an exceptionally large tumor at the start. In both cases there was practically no regression, and the consideration comes to mind that possibly both mice had damaged livers to begin with. Otherwise, no organ injury of any kind has been found in 100 animals that have come to autopsy to date.

In Series A (carcinoma) decreases in tumor size were noted in all cases. Complete regression was noted in 25–83 per cent of the cases, depending on the KR preparation used and the number of injections made. In spite of the exploratory nature of the experiments, complete regressions were noted in 55 per cent of the cases, and regressions of better than 50 per cent in over 90 per cent of the cases. Fifteen per cent of the animals were kept alive and have shown no return of the tumors grossly in the course of 1–2 months. This work is being continued.

At the present writing 40 sarcoma 180 mice are undergoing treatment and are healing. Only one group is reported in Table 2, showing complete regression in 9 out of 11 and 1 failure. In 15 controls, untreated by KR, 2 animals showed signs of regression which was sufficiently slow to weed them out from the experiment proper and testing with KR. When regressions occur with KR, the effect is, on the contrary, rapid and clearly connected with the injections. The one complete failure defies explanation at present because of the autolysis of the organs of the animal found some time after death. It must be remembered that we have screened animals for test with active KR when they were as near death as possible.

A set of 14 healthy animals were tested with KR, receiving 4 times the therapeutic dose in a series of 11 injections, and sacrificed. All organs were found normal on autopsy and histological examination.

The experiments are being continued on a larger scale and with a larger variability of the numerous factors that enter into the situation.

Our experiments show that the endotoxin of *T. cruzi* exerts a selective lytic effect on malignant tumors in mice, such as spontaneous mammary carcinoma and sarcoma 180.* The endotoxin is not toxic to normal tissues under the conditions of therapy and in concentrations 4 times as great.

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Male Sterility in the Carrot

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Male sterility has been reported in several crop plants including tomato (*3, 6, 9*), flax (*2*), corn (*4, 8*), onion (*5*), sorghum (*1, 10*), barley (*11*), and sugar beet (*7*), and the possibility of utilizing this character in the production of hybrid seed for commercial planting has been pointed out by several investigators. Present horticultural varieties of carrots lack uniformity when environmental conditions deviate from the optimum. By studying the combining ability of paired inbred lines, one in each combination possessing the male-sterile character, it is theoretically possible to obtain extremely uniform carrot varieties which are also superior to those now available in general appearance, productivity, quality, and nutritional value. The feasibility of using inbred lines of corn in producing seed for commercial planting is due to the monoecism of the plant and the ease in making cross-pollinations. In perfect-flowered plants like the carrot it is impractical to employ inbred lines in this way without male sterility.

An apparently male-sterile carrot plant was found in a collection of several dozen being grown for inbreeding in a greenhouse planting in the winter of 1945–46 at the U. S. Regional Vegetable Breeding Laboratory, Charleston, South Carolina. This plant was grown from a root selected in a commercial stock of the variety Tendersweet in the spring of 1945. Caging of certain umbels took place a day or so before the first flowers normally would open, and the caged umbels were observed daily for the appearance of exserted stamens, the stage at which blowflies are introduced into the cages as pollinating agents. The first flies were placed in the cage on February 25, 1946, even though no stamens were evident. A few days later microscopic examination showed that the anthers of this plant were shriveled and brown in color before any petals unfolded. No exserted stamens were found. On March 9, 1946, an umbel of the variety Nantes Strong Top, grown from a root selected from a commercial stock in the spring of 1945, was placed in a test tube of water and introduced into the cage with the apparently male-sterile plant. This procedure was continued with fresh umbels from the Nantes plant. Later the two entire plants were isolated in a single large cage. The seed on the selectivity caged umbels was harvested separately from the other umbels because some seed had set on the male-sterile plant outside the small cage by open pollination before the whole plants were enclosed. The pollen parents of these seeds were unknown. Female fertility of the male-sterile plant appeared normal.

On September 6, 1946, a portion of the hybrid seed was planted under good conditions. The 67 roots which were produced were harvested on January 6 and 28, 1947, and held at 32°–35° F. until they were planted in the field between February 21 and March 18, 1947, at 5 different locations. The histories and internal characteristics of all roots were recorded.

Classification of the flower types of these F_1 plants between June 6 and July 7, 1947, showed 39 male-sterile and 15 normal. The balance of the plants to make the total of 67 planted either had not flowered when the last notes were taken or were lost before classification. No difficulty was encountered in distinguishing between male-sterile and normal plants. The abnormal specimens appeared like the parental male-sterile plant found in the winter 1945–46 greenhouse planting. The mode of inheritance of the male-sterile character is unknown, because so far only a relatively small segregating population has been studied. Further breeding tests will be required before a genetical explanation can be proposed.

In order to determine whether male-sterile plants produce any self-fertile pollen, umbels of four segregates were caged with blowflies. Three of these plants set a few seeds. If enough plants can be grown from these seeds, proof should be obtained as to whether these were really selfed seeds or were cross-pollinated from normal plants by thrips, ants, or some other very small insects that penetrated the fine-mesh cloth cage covering. Umbels were not allowed to touch the cloth, thus eliminating the possibility of insects outside the cages pollinating enclosed flowers pressed against the inside of the cloth. Isolated plantings of single male-sterile plants and other plantings with several male-sterile plants would give further information on the possibility of viable pollen production.

At the time the F_1 population involving male sterility was being classified, several dozen plants in other carrot breeding lines were examined for flowering habit. Four plants were found to possess varying degrees of apparent male sterility. Each plant produced some exserted stamens, but the number was only a small percentage of those which would normally be exhibited. Two of the specimens shed pollen, the viability of which was not determined, but no pollen production by the remaining two plants was observed. All four set an abundance of open-pollinated seed. This partial male sterility was not encountered in classifying the F_1 population which was segregated for the male-sterile character.

The mode of inheritance in the carrot of the male-sterile character, for which segregation data were presented, and the partially male-sterile types with which no controlled crosses were made will not be known until additional breeding tests are completed.

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IN THE LABORATORY

Solubility of Iron in Submerged Soils

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While studying the water-soluble ions in the Brookston and similar soils from the vicinity of Chatham, Canada, an interesting phenomenon was observed that undoubtedly has a bearing upon the growth of certain crops in some seasons. On August 25, 1947, 24 samples of Brookston silty clay loam soil, A_p and B horizons, were used in the study of the water-soluble ions. The procedure (Fig. 1) consisted of placing 50 grams of soil inside a collodion bag in a 150-ml. extraction flask. Then 50 ml. of distilled water was added to the soil inside the bag, and another 50 ml. was placed on the outside of the bag. The bag was lifted slightly and held in suspension by stoppering the flask.

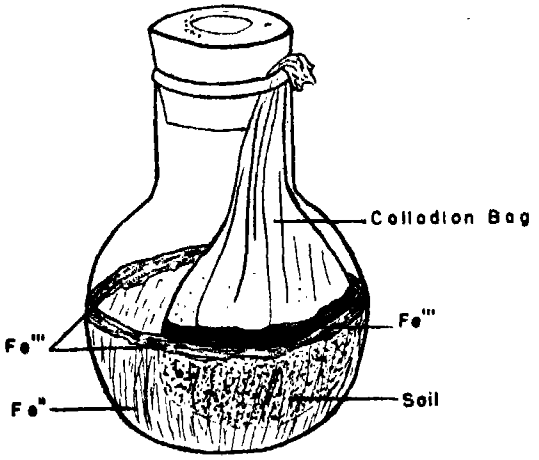

Fig. 1. Dialysis of soil in collodion bags

TABLE 1

Water-soluble Iron* in Brookston Clay Loams

Soil horizon	Ferric iron	Ferrous iron
A_p	12 ± 5	24 ± 9
B	6 ± 1	21 ± 9

* Parts per million in the soil (mean of 24 samples, pH 6.7-7.2).

After the first analyses of the solution outside of the bag were made, the flasks were allowed to remain stoppered tightly, undoubtedly creating anaerobic conditions. After about one week a brown iron stain began to accumulate on the surface of the soil. On September 6, analyses of the water outside of the bag were made for ferrous and ferric iron.

The results in Table 1 show that considerable ferric iron was in solution, and an even larger amount of ferrous iron. Since the top soil had more soluble iron than the subsoil, undoubtedly the breakdown of the organic matter was influencing the solubility of iron. The pH value of the soils was near 7.0. By October 11 all of the ferrous iron had been oxidized to ferric iron, had collected on the flask and bag at the water level, and had precipitated in a gelatinous mass in the bottom of the flask.

Phosphates were not found in solution. Iron phosphates are of low availability to tomatoes (*1*) and other vegetable crops, particularly at a pH value near neutral. In at least two of the last 10 years, phosphorus deficiency on tomatoes has been exceptionally noticeable in the Chatham area in Canada and in the Toledo, Ohio, area. This occurred after a cold, wet spring. It is believed that the above phenomenon offers an explanation of the extreme phosphorus deficiency. In other words, once these heavy soils are packed down and water remains on them for several days, a suboxidation condition similar to that described above is set up. When wet, cold springs occur, early, deep, and thorough cultivation should help to prevent the purpling (phosphorus deficiency) of the tomato crop.

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A Simple Calculator for Certain Types of Instrumental Data[1]

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Employing the nomographic principle of similar triangles, we have produced a simply constructed device which is of considerable value in converting the deflections recorded by optical manometers into their equivalent pressure measurements. Extensions of the underlying principle permit ready application of this apparatus to a number of other types of instrumental data.

In many situations, an instrumental reading, y, bears the following relation to the quantity, x, being measured:

$$y = k \cdot f(x), \qquad (1)$$

k being a proportionality factor. In some instruments, such as optical manometers, k may vary with the age and the con-

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[1] The work described in this paper was supported by U. S. Public Health Service Grant No. 101.

ditions of membrane and mirror mounting, and in other types of instruments k may be altered at will.

Graphic representation of the relations between x, y, and k may be obtained as follows: Two parallel scales are constructed. One of them, a linear scale, will be the y scale; the other will be plotted as an f(x) scale. The plots for successive values, y and f(x), are placed to run in opposite directions on the two scales. A proportionality (k) scale may be laid out on a line joining the origins of the y and f(x) scales. If both parallel scales are plotted in identical units of linear measure and b is the distance between the two origins, the proportionalities represented by a point at the distance "a" from the origin of y scale will be

$$k = \frac{a}{b - a}. \qquad (2)$$

Solving Equation 2 for a, the positions of points for a proportionality scale may be computed from

$$a = \frac{kb}{k + 1}. \qquad (3)$$

Inspection of Equation 3 indicates that a full range of proportions from zero to infinity is included in the k scale.

For the sake of compactness and ease of reading, we construct the y and f(x) scales on the vertical sides of a square and the k scale on the appropriate diagonal. In some cases it might be preferable to treat the quantity being measured as y and the instrument reading as x.

A straight line joining an instrument reading on the y scale to the corresponding known quantity measurement on the f(x) scale will cross the k scale at a point determined by Equation 3. Straight lines passing through this point and various values of instrument readings on the y scale will intersect the f(x) scale at values corresponding, respectively, to the quantities being measured.

Since the deflection of an optical manometer beam is almost directly proportional to the applied pressure, we have made the f(x) or pressure scale of our calculator linear (Fig. 1). For the sake of simplicity we plot no values on our k scale but employ it merely as an index line.

To use the calculator, we join a known value on the pressure scale with its corresponding value on the deflection scale by means of a straight hairline inscribed on a thin, transparent strip of cellulose acetate. The strip is then shifted along its long axis until one of a number of regularly spaced small holes drilled along the straight line exactly overlies the index line. A push pin pressed through this hole into the wooden base underneath serves as a pivot for further settings. To calculate other pressures registered by the same manometer, the cellulose acetate strip is rotated so that the hairline intersects the deflection scale at points determined by measurement of the manometer record. The readings of the hairline on the pressure scale will then yield the corresponding pressure values.

Although proportionality factors are readily set up on a slide rule, our calculator appears to possess certain advantages not obtainable in a slide rule: (1) The scales are large, uniform, and easily read. (2) The scales are "tailored" to fit the ranges of values in which we are interested. Thus, in passing from values of less than 10 to greater than 10, as frequently occurs in our records, it is not necessary to change the setting of the calculator as it would be when using the ordinary C and D scales of a slide rule. (3) The mechanical manipulation of our calculator, once a point on the index line has been established, is considerably simpler than with a slide rule. The advantages of this feature become apparent in the analysis of lengthy records. (4) Because there are no sliding scales in apposition, the scales of our calculator are easier to read than those of a slide rule. (5) The scales of our calculator are labeled specifically as to type and units of measurement. Thus, the tyro is able to grasp the significance of the scales almost immediately and can learn to use the calculator satisfactorily with a few minutes of instruction and practice.

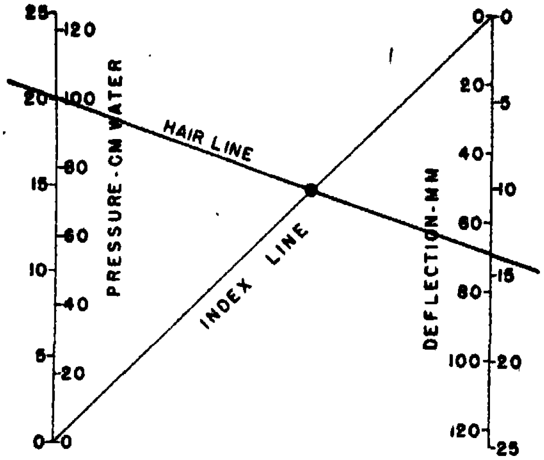

FIG. 1. Scheme of pressure calculator. Scales, plotted on millimeter paper, are 25 cm. long and 25 cm. apart. Usually the two outer or two inner scales are employed, and an index line setting for one pair of scales will serve for the other pair. Outer scales may be paired with inner scales, but individual index line settings must be determined for each of such combinations. Remainder of description is in text.

Other possible uses of this type of calculator are readily apparent. For instance, a linear f(x) scale would be useful for devices employing the strain-gauge principle. A quadratic f(x) scale should prove quite valuable in connection with flowmeters such as the orifice meter described by Gregg and Green (*1*). In other devices, such as the variable capacitator described by Lilly (*2*), f(x) cannot be expressed in simple mathematical terms, but suitable values for plotting the f(x) scale could be obtained from calibration of the instrument. Another form of this type of nomograph possesses linear y and f(x) scales, but the magnitude assigned to various points on the proportionality scale are k^2 rather than k (cf. Eq. 2). This constitutes a graphic representation of the law of inverse squares which we have found useful in calculating the correct photographic exposure for a given distance from a known exposure at another distance.

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A Concentric Glass Electrode Assembly for pH Measurements

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The electrode assembly described below, which can be made from materials usually available in laboratories, is believed to offer the advantages of good shielding and compactness.

In this design the stem of the glass electrode is placed within a slightly larger tube. The annular space between the two is filled with KCl solution and serves not only as the salt bridge of the reference electrode but also as an electrostatic shield. Such a concentric electrode assembly is particularly convenient for measuring the pH of samples in test tubes. Several electrode assemblies of this type have been built in which the outside diameter is less than 6 mm.

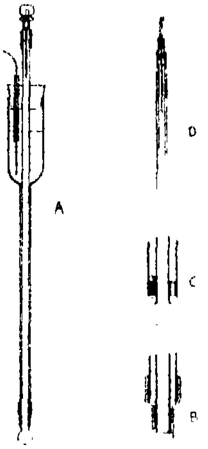

FIG. 1

In the type shown in A, Fig. 1, the annular space is closed at the bottom by a piece of Tygon tubing. This tubing is chosen to fit closely but without stretching over the stem of the glass electrode. It is then softened by steaming and forced over the end of the outer tube. The stem of the glass electrode just above the bulb is roughened on a coarse wheel or by filing (this may be done before the bulb is blown) to provide multiple fine channels through which the KCl can creep and establish a flowing junction with the sample to be measured. The outer surface of the stem of the glass electrode is wet with KCl solution and then slid up through the Tygon bushing. Assemblies which show only a very slow outflow of KCl have functioned satisfactorily. In time the Tygon may contract so as to cut off this flow, but this can be re-established by steaming the bushing in place and putting the lower end of the electrode assembly under gentle suction to draw KCl through.

Several modifications have been developed in this laboratory. A "window" type electrode may be protected by cutting the bushing diagonally and allowing one or more points to project below the delicate glass membrane (Fig. 1, B). In place of the Tygon bushing, a ring of gum rubber may be inserted between the stem of the glass electrode and the outer tube (C). Outflow of KCl is controlled by a tuft of fibrous material such as glass wool, asbestos fiber, etc., placed beneath the rubber ring before the electrode is inserted in the outer tube.

In Fig. 1, A, the KCl reservoir surrounds the stem of the glass electrode. Although this type is simple to make, it cannot be completely shielded, and electrical leakage through the stopper is apt to occur. In the design shown at D the reservoir is put at one side, connected either rigidly by glass or, if at some distance, by flexible tubing. The reference electrode is placed in this reservoir. The annular space for ½–1 inch above the side arm is filled with a mixture of half rosin and half beeswax. As this mixture is a good dielectric and forms a firm, moisture-tight bond with glass, the stem of the glass electrode needs only to extend far enough above the outer tube to fasten the Ag-AgCl electrode to it.

Electrical leakage to the reference electrode is practically eliminated, and, while supplementary shielding is easily accomplished, the short distance which the unshielded conductor is exposed usually makes it unnecessary.

Although no measurements have been made, electrical leakage through the stem of the glass electrode does not appear to be of much practical importance. Successful assemblies as long as 14 inches have been made using ordinary 7- or 8-mm. soft glass tubing for the stem. Heavy-walled barometer tubing has been used but appears to make no difference.

Other types of half-cells could probably be adapted for use with this arrangement, but the author has used silver strips plated with AgCl.

For the reference electrode these are conveniently made by soldering the silver strip before plating to a length of insulated copper wire. This is slipped into a glass tube which is then filled with the molten beeswax-rosin mixture so that the soldered joint is completely covered.

A similar strip may be used to establish contact with the buffered KCl solution within the glass electrode (D), or an insulated binding post (EBY Junior Post) can be used so that electrodes may be readily connected to a pH meter (A). The silver strip is soldered to the brass binding screw before being imbedded in wax. A Tygon collar holds the assembly in place and prevents evaporation of the solution in the glass electrode.

Staining of Oyster Larvae as a Method for Studies of Their Movements and Distribution

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The free-swimming larval period of the American oyster (*Ostrea virginica*) is of considerable duration, sometimes lasting several weeks. During this period the horizontal and vertical distribution of larvae may be controlled by tides, tidal currents, and other factors. Because of different ecological conditions, the behavior of the larvae in different areas may show considerable variations.

In conducting observations on the movements and distribution of larvae, investigators, as a rule, have had to deal with unknown populations, because no method had been developed to mark the larvae of known broods so that they could be easily identified in plankton collections. Such a method is offered here.

Experiments on developing a method for marking oyster larvae were begun in our laboratory in 1944 by Loosanoff and

Tommers. Thinking that eggs could be stained while still in the gonads of the oysters, so that they could later be normally discharged and develop as colored larvae, we placed oysters in solutions of nile blue sulfate and of neutral red. Although the gills and palps of the oysters were deeply stained, the color of the eggs remained unchanged.

The next step consisted in staining unfertilized and fertilized eggs with the same two dyes. They stained well, but, because both stained and control individuals soon died, it was impossible to ascertain the real value of the method. Lack of time and lateness of the season prevented continuation of the experiments. These were, however, resumed by the writers in 1947, the following stains being used: alizarin red S-7, Janus green, neutral red, nile blue sulfate, and trypan blue. They do not, of course, exhaust the list of vital stains that may be tried for this purpose.

The eggs and larvae treated with trypan blue and alizarin red S-7 survived and continued their development, but even after long exposures to these stains the color was too light to be of value in distinguishing stained from unstained individuals. Janus green, generally used for vital blood staining, quickly killed the eggs and larvae. Nile blue sulfate also gave unsatisfactory results because, although the eggs and larvae acquired a deep-blue color, their development was quickly stopped and usually they soon died. In one instance only, the organisms stained as trochophores developed into veligers, *i.e.* the straight-hinge-stage larvae. These, nevertheless, soon died.

In experimenting with neutral red we found that satisfactory results can be achieved, regardless of whether eggs, trochophore, or straight-hinge larvae are used. Staining did not interfere with fertilization. After the addition of sperm, the stained eggs developed normally, the progress of the development was the same as in control eggs, and the mortality was no higher.

In some experiments the oysters were allowed to spawn in a solution of neutral red. The eggs were later fertilized and proceeded to develop normally at the same rate as the control.

The trochophore larvae, developing from the eggs treated with neutral red before or after fertilization, showed a deep-reddish color over their entire surface. After developing into the straight-hinge stage, the larvae still were deeply stained, the color being most intense along the edges of the mantle. Later on, the color became concentrated in several comparatively large areas of their bodies. About 11 days after they were stained as eggs, the larvae were still easily distinguishable from the controls by a large red spot near the stomach.

Trochophore larvae, stained 12 hours after fertilization, developed into normal straight-hinge larvae. They retained the red color the same as the larvae which developed from stained eggs. However, the veligers stained in the trochophore stage retained the color somewhat longer than those which developed from the eggs stained before or soon after fertilization.

In staining young veligers we noticed a certain inconsistency in the results. As a rule, the larvae concentrated the stain in a comparatively large area near the stomach, while the other parts of the body remained almost unstained. On a few occasions, however, the stain was generally distributed through the body, being most intense in the velum and along the edge of the mantle. In either case the stained larvae were easily distinguishable from the controls for a period of at least 10 days.

Older veligers, some as large as 300 μ, were also stained with neutral red. However, although the velum and other parts of the body, such as the mantle, became deeply stained, it is doubtful, because of the dark color and relative thickness of their shells, that they could be easily identified in preserved plankton collections.

In our opinion, the best stage for staining is the trochophore larva. Under laboratory conditions fertilized eggs can be carried to that stage without much difficulty. After staining, the trochophores may be released and should soon reach the early veliger stage.

To stain eggs or larvae we kept them for approximately 20 minutes in a solution of 1 mg. of neutral red in 1 l. of sea water, after which the water was either changed or greatly diluted. Of course, many variations of the method are possible by prolonging the time of exposure or by using stronger concentrations. However, in each case it should be ascertained whether the variation of the method would result in heavy mortality of larvae.

The method offered here presents rather broad opportunities for studies, under natural conditions, of vertical and horizontal movements, distribution, dispersal, and perhaps even the rate of growth and survival of oyster larvae and probably of other lamellibranchs. The latter will be ascertained by our experiments next year. Because our incidental observations showed that many other forms, such as barnacle larvae, copepods, many other crustaceans, ctenophores, worm larvae, etc., remain alive and apparently healthy after staining, the method may also be used for studies of distribution of a wide variety of plankton forms.

Incidentally, in staining the adult oysters we noticed that the boring sponges, such as *Cliona celata*, which inhabit their shells became deeply colored. The sponges retained the stain, especially nile blue sulfate, for several weeks and showed no ill effects of the treatment. Perhaps this observation could find application in some aspects of sponge studies.

A Precision Micro-Pipette Trimmer

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The need for a precise and easily used tool for trimming the micro-pipettes and micro-needles used in micrurgical studies is apparent to all students in this field of investigation. Belkin (*1*) designed a micro-guillotine for this purpose to be used with a Chambers micromanipulator, but the instrument appears not to be adjustable and requires some dissembly of the two-movement manipulator setup. The present paper describes a simply constructed and efficient instrument for trimming micro-pipettes and micro-needles for use with the Chambers (*2*) micromanipulator.

The instrument may be made of plastic or brass. The bulk of the instrument consists of two fitted flat jaws: a U-shaped rear jaw (Figs. 1A, 2A) and a rectangular-shaped front jaw (Figs. 1B, 2A) fitted between the arms of the rear jaw. The two jaws are held in mutual position by two guide bolts (Fig. 1C) which pass through counter-sunk channels drilled through the back edge of the rear jaw and which are screwed into the apposing edge of the front jaw (Figs. 2A, 2C). The guide bolts function only to facilitate the general handling of the instrument and to limit the extent to which the jaws may be opened. A centered groove ¼ inch wide by 3/16 inch deep, extending the length of the front jaw and coinciding with a similar but short groove in the apposing edge of the rear jaw, forms a pipette-run (Figs. 1D, 2B). An Alnico steel instrument magnet is cemented into an appropriately sized hole drilled in each half of the front jaw (Figs. 1E, 2A). A standard double-edged razor blade (Fig. 1F) properly oriented by a fixed blade stop (Figs. 1G, 2C) and held down by a clear plastic plate (Figs. 1H, 2C) with two screws provides the functional cutting edge (Fig. 1I) of the front jaw. That of the rear jaw (Fig. 1J) is also provided by a standard, double-edged razor blade. This blade rests on the top of a narrow ridge (Figs. 1K, 2C) consisting of a plastic strip cemented across the basal part of the rear jaw. The blade is oriented with its functional cutting edge paralleling that of the front jaw by two posts 3/16 inch in diameter, screwed into the ridge and rear jaw (Figs. 1L, 2A, 2B). The blade is held in position by an arched metal plate (Figs. 1M, 2C) controlled by two thumbscrews (Figs. 1N, 2). By turning the thumbscrews, the arched plate raises or lowers the functional cutting edge of the rear razor blade. This makes it possible to align the cutting edge of the rear jaw with that of the front jaw for maximal cutting efficiency.

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[1] I would like to extend my thanks to Ernest F. Hiser, of our Art Department, for the preparation of the illustrations and also to our Pharmacology Department for making its machine tools available to me.

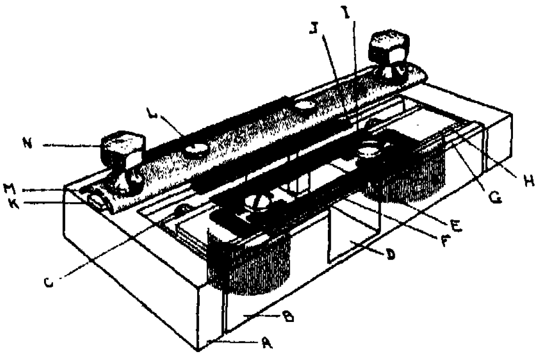

FIG. 1

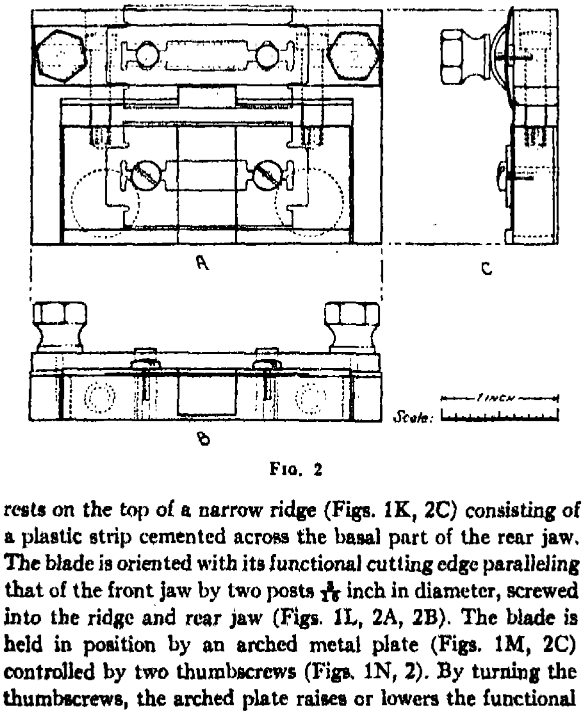

FIG. 2

It will be noted from study of the construction plan (Fig. 2) that the width and length of the instrument, even with the jaws wide open, and the height of the pipette-run are the same as those of the standard moist chamber used with the Chambers micromanipulator (*3*). Thus, when one with his micromanipulator assembly completely set up finds it necessary to trim the micro-tips, he needs to remove only the moist chamber from the assembly by the usual procedure without disturbing the centered micro-pipettes and to substitute in its place the *micro-trimmer* with the open end of its pipette-run facing the micro-pipettes. The micro-trimmer is moved forward by the mechanical stage until the two functional cutting edges (which will be closed by this maneuver) are brought into the field of the microscope. The cutting edges are then separated from each other by racking the mechanical stage slightly back. In this maneuver it will be observed that only the real rear cutting edge is moved by the mechanical stage. For this reason, it is referred to as the mobile cutting edge. The real front cutting edge, being quite firmly held by magnetic attraction to the microscope stage, remains stationary and is referred to as the stationary cutting edge. Thus, slight backward and forward racking of the mechanical stage opens and closes, respectively, the functional cutting edges. With the cutting edges almost closed, the mobile cutting edge is lowered by means of the thumb-screw controls until it can just pass above the stationary one. When the cutting edges are satisfactorily aligned, they are opened as indicated above. By means of the micromanipulator controls, the already centered micro-tip which is to be trimmed is elevated to the desired level above and rested against the stationary cutting edge. The mobile jaw is then closed. This closure shears the micro-tip off at precisely the level of the stationary cutting edge. After the pipette has been trimmed, it is lowered by the appropriate micromanipulator control to a position beneath the stationary cutting edge. The micro-trimmer is then removed from the manipulation assembly without disturbing the centered micro-pipettes just as though it were a moist chamber. The moist chamber initially removed is put back into its original place in the complete micromanipulation assembly.

The detailed measurements necessary for the construction of the micro-trimmer may be accurately obtained by applying the 1-inch scale in Fig. 2 to the construction plans (Figs. 2A, 2B, 2C).

In fitting the jaws and the guide bolts, it is essential to reduce all friction to a minimum; otherwise, the magnets cannot satisfactorily immobilize the front jaw at the appropriate times in operational use.

If cylindrical magnets are set into the front jaw, care must be taken to avoid getting like magnetic poles of the two magnets at the same jaw surface. This is necessary, since the complete magnetic circuit when on the microscope is: N-pole of 1st magnet—microscope stage—S-pole of 2nd magnet—N-pole of 2nd magnet—front razor blade—S-pole of 1st magnet. Preferably, any small but powerful instrument magnet of a modified horseshoe shape may be used if its dimensions do not exceed 15 mm. in diameter and ⅝ inch in height.

References

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2. CHAMBERS, R., and KOPAC, M. J. In *Microscopical technique*. C. E. McClung. (Ed.) New York: Paul B. Hoeber, 1937. Pp. 62–109.
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Book Reviews

Estimation of the vitamins. (Biological Symposia, Vol. XII.) W. J. Dann and G. Howard Satterfield. (Eds.) Lancaster, Pa.: Jaques Cattell Press, 1947. Pp. xiv + 531. (Illustrated.) $6.50.

There are about 15 vitamins which have been clearly characterized and which are of importance directly or indirectly to man. From one to many methods have been proposed for the estimation of each of these in food and biological fluids. Descriptions of these many methods are widely scattered in the scientific literature, some of them are but slight variations of others, many are of questionable merit or of limited application. The time is more than ripe for a critical evaluation of the situation. This has been done in a thorough and competent manner in this new book, which should be in the library of anyone interested in the estimation of the vitamins.

Each of the 29 chapters which the book contains is written by a contributor who has had intimate experience with the subject. The editors have done unusually well in their selection of contributors, and the authors have done unusually well with their assignments.

Available methods based on biological, microbiological, and physical and chemical principles are included. In each case a recommended method is presented along with a critical discussion of the details of the method, its limitations and merits. This is a book which should find wide and heavy use.

Otto A. Bessey

The Public Health Research Institute
of The City of New York, Inc.

La perception de la causalité. A. Michotte. Louvain: L'Institut Supérieur de Philosophie; Paris: J. Vrin, 1946. Pp. viii + 296.

It is with a certain feeling of excitement that one begins the reading of a book with a title as intriguing as *The perception of causality*, written by a distinguished psychologist.

In his experimental technique, Michotte takes off from the classic example of causality used in philosophic discussion—the impact of one billiard ball on another. To find out what are perceived as "causal phenomena," he used a projection technique in which two disks could be observed behind a screen in various relations to each other. Variations in speed, distance, angle, temporal, spatial, and kinetic order were controlled to determine the conditions and limits of what were perceived as causal relationships.

Whether or not a person experiences a "causal impression" is held to be entirely a matter of the structural organization of the perceptive field, of the intrinsic properties of stimuli organized in certain spatial and temporal relationships. The author relies heavily on Gestalt psychology and believes that "the perception of causality is as 'objective' as all other perceptions."

What he terms the "generative aspect of causal impression" is also a phenomenal given. Luckily for man, he says, there exists a high correspondence between the physical world and the phenomenal world, between the laws of mechanics and the properties of causal impression. Causal impressions of qualitative change, he maintains, are limited to combinations of movement or changes of form.

Whether or not one agrees with Michotte that his interpretations are both valid and adequate, he has performed the great service of pointing out the paradoxes that must be resolved because of the inadequacy of our up-to-now understandings of the type of phenomena he investigated. But, in the reviewer's opinion, it is risky to apply generalizations obtained from the perception of billiard ball situations to "causality" as conceived when we try to understand an individual who exhibits purposive behavior, who initiates voluntary actions, and who makes value-judgments in his effort to modify in the present the causes of what he foresees as future effects.

Adelbert Ames, Jr.

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Hanover, New Hampshire

Psychoanalytic therapy. Franz Alexander, Thomas Morton French, *et al.* New York: Ronald Press, 1946. Pp. xiii + 353. $5.00.

This volume, the fruit of 7 years of research at the Chicago Institute for Psychoanalysis, offers perhaps the best statement of the possibilities and limits of brief psychotherapy that has appeared in psychological literature to date. The book should have a profound influence on the future course of psychiatry, social work, and clinical psychology. In the choice of a title and in their text (pp. 208, 338–339), the authors indicate that they would prefer to have their theories and techniques regarded as "psychoanalytic." The orthodox analysts who have reacted to the book apparently think otherwise. The modes of therapy reported by Alexander and his co-workers are anything but "analytic," in the sense of being "Freudian." They are patterned in the main after the thinking of two of Freud's great contemporaries, Otto Rank and Alfred Adler. For their dynamics of *therapy*, or their clinical approach to the individual who is suffering from an emotional disturbance, Alexander and his colleagues are indebted for the most part to Rank (pp. v, 22–23). As for their dynamics of *personality*, or their theories of the structure of neuroses—which the therapist must grasp quickly if he is to make a success of shortened psychotherapy (pp. 11, 172, 262–263)—the Chicago group would seem to be Adlerian through and through. (Such is the conclusion one is forced to draw after making a close examination of the volume's excellent case histories.) The Chicago Institute for Psychoanalysis is not alone in this seeming rediscovery of Rank and Adler. Psychiatry and clinical psychology as a whole seem to be drifting in the same direction. Adler has come to life in other vigorous circles, notably in the publications of the "Horney" school. The fertile Philadelphia School of Social Work owes its orientation to Rank. Rank is also the father (who might have some difficulty recognising his child) of the nondirective therapy which is the accent of the moment in a good many of our university departments of clinical psychology.

KEITH SWARD

Beverly Hills, California

The physical principles of wave guide transmission and antenna systems. W. H. Watson. Oxford, Engl.: Clarendon Press, 1947. Pp. xiii + 208. (Illustrated.) $7.00.

This book is an advanced text intended for the research engineer or physicist who is specializing in the subject of microwaves. A very good background in mathematics is necessary in order to understand the book fully. However, the author has included much information which is the result of practical experience in the field.

In the early chapters the author reviews the basic equations of plane wave, slab line, and rectangular wave guide transmission. Matrices are used extensively throughout the book in an effort to simplify the mathematics.

In Chapter III there is a practical discussion of microwave measurements.

Babinet's principle is used as a basis for computing the effect of obstructed propagation in wave guides. Gratings, irises, slots, and other discontinuities which are found in wave guide work are all treated in considerable detail. The author has devoted much space to an excellent treatment, both theoretical and practical, of various types of slots in wave guides, guide coupling by slots, and wave guide arrays. Wave guide slot arrays were a wartime development of McGill University, where the author was working. Cavities, phase changers, magic-tees, and some more of the later developments in microwave work are touched upon.

The book makes a real contribution to the microwave field in that it will do much to bring the research worker up to date in several phases of microwave techniques.

LA VERGNE E. WILLIAMS

University of Connecticut, Storrs

Basic botany. Fred W. Emerson. Philadelphia-Toronto: Blakiston, 1947. Pp. xi + 372. (Illustrated.) $4.00.

This is a refreshing new textbook of elementary botany which continues the recent trend away from the ponderous and sometimes pedestrian tomes characteristic of so many books for students. The departure from the conventional starts with the cover, which is a landscape scene in color from New Mexico or vicinity. The arrangement and treatment of the subject matter, while not so startling, is sufficiently different to be challenging to those familiar with the more orthodox texts. The author's style is fresh and unstilted, the illustrations adequate and often admirable, and the scope the usual one of morphology, physiology with chapters devoted to genetics and evolution, plus excellent sections on plant classification, ecology, and conservation.

Criticism of the text can be made on two minor points. The author plainly considers evolution to be a law, as it is, but persists in calling it a theory. The other criticism is directed at the drawings of mitosis, in which there appears a spindle figure in prophase, an error perpetuated in most botany texts, diagrams, and charts. In the excellent text description of the process, however, no mention is made of the appearance of a spindle before the disappearance of the nuclear membrane. In the preface, the author states as his conviction that both students and teachers learn, study, and investigate under the drive of significance, and that freshness and spontaneity should characterize the atmosphere of classroom and laboratory. It is good to hear of a botanist who believes in his subject, and one finds in this book none of those desperate attempts to justify the business usually entitled 'why study botany.' Those who confuse measured monotony with scholarship will probably not like this book.

EARL H. NEWCOMER

University of Connecticut, Storrs

Physical chemistry. E. D. Eastman and G. K. Rollefson. New York-London: McGraw-Hill, 1947. Pp. viii + 504. $4.50.

This text is "designed to meet the requirements of the year course in physical chemistry usually presented to third- or fourth-year college students and to serve as a reference book in later work." The authors have written for mature students and have, I think, achieved their purpose admirably.

Three introductory chapters explain the objectives and methods of physical chemistry and define such terms as *system*, *conditions*, *potentials*, *components*, *changes in state*, etc. This should give the student a perspective that often comes only after the course is nearly over; as a preview, these chapters evince a keen pedagogical insight. The range of topics in the remaining 23 chapters is fairly conventional, but the rigorous treatment and fine writing give them an unusual vitality. For example, Chapter IX, "Energy and Heat Capacity of Gases and Crystals," is a well-integrated account of classical and modern views ranging from the work of Clément and Desormes in 1819 to Raman's contributions in 1941. In Chapters VIII, X, and XII are presented the current ideas on the structure of solids and liquids; although these 68 pages are mostly descriptive, they have a high intellectual specific heat. The important chapters on thermodynamics, equilibrium, and kinetics are remarkably free of that most common fault of elementary texts—the failure to distinguish between exact and approximate relationships. An example of this kind of error occurs in applying the First Law to processes taking place under constant pressure or constant volume. The authors distinguish the energy changes by the use of subscripts in the terms ΔE_p and ΔE_v, but this distinction is subsequently ignored in the statement (p. 45) that the difference between the heats of reaction at constant pressure and at constant volume is always calculable from the equation: $\Delta H_p = \Delta E_p + P\Delta V$. Although $\left(\frac{\partial E}{\partial P}\right)_T$ is relatively small, thermochemists do measure it, and it is unfortunate that nearly every popular text treats this fundamental subject incorrectly. A similar oversimplification occurs in Chapter XXI, where the equilibrium constant for the reduction of ferric iron by iodide is calculated from electromotive force data. It should be emphasized that, in actual systems encountered by the student, the presence of phosphates or fluorides can result in the quantitative reversal of the equilibrium predicted. Later in the same chapter, a beautiful graphical picture of the effect of ionic strength on a similar equilibrium of ferric-ferrous iron should make the alert student ask questions about the former.

On the other hand, we can easily find many places where the authors show exceptional care. In discussing the hydrolysis of bicarbonate ion, they point out that either of the simplifying assumptions made in calculating the pH gives an answer far different from the experimental value. By any standards this text should join the highest rank of its kind. The content of the book reveals a mastery of the subject, and the style in which it is written reveals the beauty. The typography is excellent, but the thin paper will probably not stand hard use.

ROBERT EPPLE

Brown University

Electric contacts. Ragnar Holm. Stockholm: Almquist & Wiksells, 1946. Pp. xvi + 398. (Illustrated.) 45:-.

Electric contacts have an important role in modern living. However, the physical principles of contact phenomena have not been correlated fully with experimental data. Present knowledge is confined largely to well-guarded production techniques and empirical formulas that the industry has amassed. This book is an attempt to describe in general terms the physics of contacts and to develop fundamental formulas in agreement with data taken by the author and colleagues over a period of some 20 years.

As noted in the text, the book was written while the author was a physicist in the Research Laboratory of the Siemens Works in Berlin, one of the outstanding industrial laboratories on the continent between the first and second World Wars. Translation of the book into English introduced some minor errors in spelling and terminology, but these in no sense lessen its technical value.

The style used by the writer is a balance of thoroughness and clarity. He begins with a complete list of symbol definitions and a qualitative résumé of the major conceptions used throughout the work. Such an introduction is necessary, because many of the symbols and terms used either have not received universal recognition or are used here to introduce new concepts, e.g. "constriction resistance" and "coherer action."

Stationary contacts are considered in Part I. The general theory of contact surfaces and contact resistance is treated in some detail. This is followed by a theoretical analysis of the interrelation between electric potential differences, temperature gradients, and impedance in contacts. The role of electrodynamic and electrostatic forces is outlined. The influence of pressure and tarnish films on contact resistance is carefully described. Tables and plates are interspersed that in the main confirm, but at times are not in full agreement with, the theory. The author goes to some lengths to point out that in many instances only the results of preliminary investigations are available, and that more detailed research is necessary before useful formulas can be evolved.

Part II is a study of sliding contacts. The concept of friction and its effect on contact resistance is treated in considerable detail. The relative physical properties of several combinations of contact materials are presented in detailed tabular form with a commentary on the observations.

Part III begins anew with a survey of the short switch arc, including a study of the VI-relationship, bouncing, oxidation, arc duration, and methods of quenching and suppression. The physics of contact erosion and transfer of matter are very clearly presented with substantiating data.

Part IV, a retrospect, is purely historical. Going back to the early experiments of Franklin and Leyden, it traces the evolution of the concept of contact resistance to the present day. A very complete author and literature index is included.

As a whole, the book is written on a plane that will qualify it as a reference text for graduate students in electrical engineering or as a handbook for industrial design engineers. Some parts of the text, printed in brevier, are intended primarily for the physicist and afford a prolific ground for the selection of problems for fundamental and applied research.

MERLE H. BRAGDON

Naval Ordnance Laboratory,
White Oak, Silver Spring, Maryland

Servomechanism fundamentals. Henri Lauer, Robert Lesnick, and Leslie E. Matson. New York-London: McGraw-Hill, 1947. Pp. xi + 277. (Illustrated.) $3.50.

The fundamental principles of servomechanisms are so presented in this book as to require a minimum background in mathematics and physics. A chapter on the fundamentals of mechanics and electricity is included, and the necessary differential equations are presented and solved in detail by classical methods. Thus, considerable review of the necessary background material is provided in the book itself.

The fundamental servo control system is developed, and its essential components are pointed out. These components are an error-detecting device which compares the actual output quantity with a given input requirement, and a controller embodying the necessary amplifiers and motors to cause the output to correspond to the input requirement. The need for damping and stabilizing devices is also pointed out. The more common error-detecting devices such as synchros are discussed fully, and several examples of servo systems are given.

The transient response of various typical servomechanisms is studied by means of classical differential equations. First, a system with a proportional controller whose only damping is the viscous friction of the output member is considered. This system has the disadvantage of a steady-state error if the input is a constant velocity. This undesirable error is found to be absent if all the damping is produced in the controller by means of an additional effort proportional to the rate of change of error. Systems with error-rate damping and combined damping are then studied. Networks for producing this error-rate stabilization are also discussed. Elimination of the steady-state error by means of integral control is then discussed, and systems with integral control are studied. Networks for producing integral control are also included.

The response of servo systems to a sinusoidal input function is mentioned in various places in the text, and a chapter near the end of the book gives an introduction to the frequency response or transfer function analysis. Nyquist's stability criterion is stated, and various plots of the transfer function are given. This chapter serves as an introduction to the more advanced treatises using this method of analysis.

Although the book has many excellent solved examples and one chapter treats typical design calculations, it is felt that its value as a textbook would be increased by the addition of a number of well-chosen problems.

F. CARLIN WEIMER

Ohio State University

Petroleum—Today and Tomorrow

Kirtley F. Mather
Professor of Geology, Harvard University

FROM ALMOST EVERY POINT OF VIEW, petroleum was "strategic mineral number one" during the World War that ended in 1945. Even the spectacular advent of the atomic bomb in the final days of the conflict did not displace it from its position of prime importance, although within a few years uranium will almost certainly be the "number one" material in the minds of military strategists, if it is not even now in that position.

It was the ceaseless flow of petroleum from the oil fields of the United States, Venezuela, the Middle East, and a few other places of lesser importance that kept the Allied Forces in motion on land and sea and in the air, the world around, and even provided them with some of the most potent of their weapons. It was the progressive attrition of Germany's supplies of oil that clipped the wings of the Luftwaffe and made possible the astonishingly swift advance of the Allied Forces from the periphery of Hitler's ill-gotten empire to its nerve center in Berlin. It was the cutting of the supply lines from the oil fields of the East Indies to Japan and the exhaustion or destruction of the Japanese stores of petroleum that presaged the capitulation of the Japanese war lords, even before the bombs fell on Hiroshima and Nagasaki. Verily, the Allied Powers rode to victory on a flood of oil.

Now that the "shooting war" is ended, and as we turn to the distressingly difficult task of arranging a peaceful world in which men may use the rich resources of our bountiful earth for the welfare of all mankind, petroleum continues to hold its leadership among the natural resources of the earth. Both as fuel and as raw material for chemical industries, petroleum will hold the center of the stage for many years to come. Hardly any other substance illustrates so fully the manner in which science and technology may be combined to achieve the utmost success in contributing to human efficiency and comfort.

Fundamental to any understanding of the problems implied by my topic is the comprehension of the fact that petroleum is a nonrenewable resource; it is in the category of nature's stored capital, not of man's annual income. It is, of course, true that the geologic processes responsible for oil pools are continuing to operate today as in the past. On the sea floor off the coast of southern California, for example, there are broad hollows where the tissues of marine animals and plants are now accumulating in mud and ooze at depths of 200 or 300 fathoms. The conditions are closely similar to those that recurred repeatedly during the Paleozoic era in Oklahoma and Texas, when the oil of certain rich oil fields was being generated. But millions of years must elapse before that organic material can be transformed into petroleum, stored in the interstices of overlying sandstones, and made available by crustal movements for recovery from wells to be drilled by some future inhabitants of the earth's surface.

In relation to the feverish haste of mankind's insatiable demands, the creative processes of nature's laboratory operate very slowly. For all practical purposes our planet must be reckoned as a storehouse of such minerals as petroleum, not as a factory in which that substance is generated year by year, or even millenium by millenium. Mother Earth has made available a cupboard richly stocked with a vast amount and a great variety of goods indispensable to us in an age of science and technology, and among these stores we find petroleum. Each year we go to the shelves of that cupboard and take away a few packages of the goods stored thereon; if we keep going long enough, some day someone will find that the cupboard is bare. Indeed, petroleum is now being used at such a rate in relation to its total amount in the earth's crust that its complete exhaustion is, from a geological viewpoint, alarmingly imminent.

Between 1859, when the first oil well was drilled in the United States, and January 1, 1947, the production of petroleum from all parts of the world has totaled nearly 52,000,000,000 barrels. Of that total, slightly more than 30,000,000,000 barrels were produced in the United States. As shown in Fig. 1, the annual production, both for the world as a whole and for the United States, has increased each year since 1938, with the sole exception of 1942, the first year of American participation in the war, and there is every indication that these increases will continue for the next few years. Indeed, it is a conservative estimate that the world's oil production will average

"Petroleum—Today and Tomorrow" was presented as an illustrated lecture before the British Association for the Advancement of Science on August 29, 1947, during the Association's meetings held in Dundee, Scotland. Dr. Mather's discourse was presented as another in the series of exchange lectures established in 1938 by the BAAS and the AAAS and is published in *Science* by arrangement with the Officers of the British Association.

more than 3,000,000,000 barrels per year during the decade 1947–56.

Such figures begin to take on real significance when we note that the most recent estimates made by competent

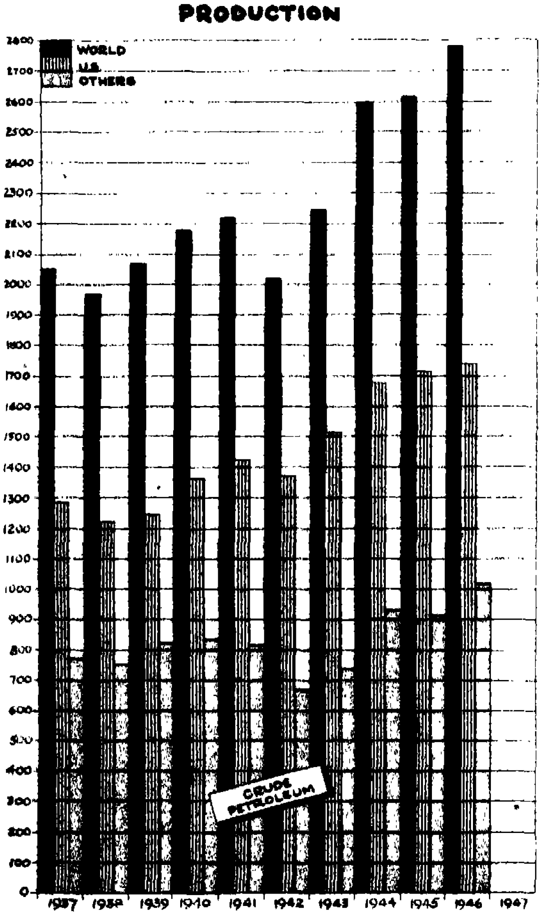

FIG. 1. Annual production of petroleum, 1937–46, in millions of barrels.

petroleum geologists (see Fig. 2) give a figure slightly less than 70,000,000,000 barrels (68,924,000,000) for the proved reserves of petroleum throughout the world on January 1, 1947. It would, however, be far too simple and quite erroneous to make the easy arithmetical calculation and announce that the world's oil will be exhausted in 23 years. The proved reserves are only a fraction of the actual reserves. Whether the fraction is one-half or one-tenth is a matter of great moment, requiring careful consideration.

The particular combination of specifically defined geological conditions requisite for an oil accumulation of economic value is now well known to petroleum geologists. Every oil field fulfills the specifications in one way or another, and the failure to find oil in an exploratory borehole can almost always be explained by an observable lack of one or more of the requisite geological conditions.

The first requirement is an adequate source of supply of the organic materials from which petroleum may be formed by natural processes of a biochemical and geochemical character. Source beds are sedimentary rocks, most commonly shale, but in some instances limestone or sandstone, in which the tissues of plants or animals were buried, before they were completely oxidized, while the sediments were accumulating on a sea floor, lake bottom, or stream bed. Certainly, almost all, and very probably all adequate source beds are of marine origin.

In the second place there must be a suitable reservoir rock in fairly close proximity to the source beds. Reservoir rocks must be both porous and permeable, in order to provide space for the oil in the interstitial voids and to permit its movement, first from the source beds into its interstices and later from them into a borehole. The best reservoir rocks are sandstones and limestones with a porosity of 5–25 per cent of their volume and with permeability ranging from 100 or 200 to 1,000 or 2,000 millidarcies. It is not essential that a reservoir rock be marine in origin; lacustrine, fluviatile, or eolian sandstones will do just as well. In fact, a volcanic ash deposit, a tuff or agglomerate, might be quite satisfactory.

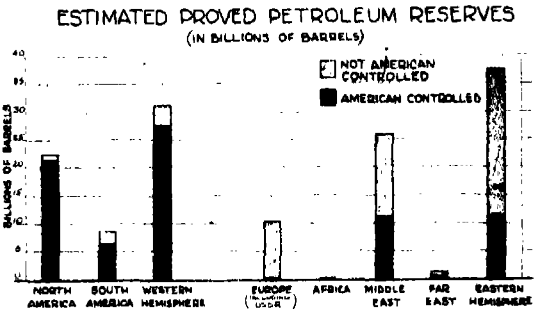

FIG. 2. Proved reserves of petroleum as of January 1, 1947.

Thirdly, there must be some sort of trap to prevent the upward migration of the oil as it seeks to ascend to the surface because of its lesser density than that of water. The trap may be (1) "structural," produced by folding or faulting of the rocks or a combination of the two, or by the intrusion of salt or igneous rock into the sedimentary series, or (2) "stratigraphic," resulting from the pinching out of the reservoir rock updip or from excessive lateral reduction in porosity or permeability within the reservoir bed, or formed by the unconformable deposition of relatively impermeable beds across the eroded edges of tilted strata that include a reservoir rock.

Finally, the sedimentary system containing source beds and reservoir rocks must not have been unduly metamorphosed, either as a result of deep burial, horizontal compression during mountain-making movements, or igneous intrusions on a large scale. Moderate pressures stimulate geochemical changes conducive to the evolution of petroleum from its source materials, but excessive pressure destroys petroleum. Gentle folds are desirable to provide structural traps and to tilt reservoir rocks so that the oil can move upward into stratigraphic traps, but closely compressed folds do not yield oil. The greatest depth from which oil has thus far been produced is slightly greater than 13,000 feet, although several holes have been drilled deeper than 15,000 feet and at least one exceeds 17,000 feet. It is extremely unlikely that oil will ever be produced anywhere from depths greater than 20,000 feet, for the pressures and temperatures are too great to permit petroleum to exist in the fluid state.

Although geological and geophysical surveys at the earth's surface permit the discovery of places beneath which one or more of these four requisites for an oil field are known to be met, no one can guarantee in advance of drilling that oil will be encountered at depth. Satisfactory criteria for the identification of source beds as such are not yet known. Sedimentary rocks are notorious for their facility to change in textural, lithologic, and mineralogic characteristics when traced laterally from place to place. There was no reason, for example, to expect in advance of drilling that the structural trap a few miles south of Lincoln, in Nottinghamshire, would be devoid of oil, whereas the very similar structure in similar rocks at Eakring, only 25 miles distant, would yield very considerable production. Not until the drill has yielded information concerning the texture and thickness of potential reservoir rocks within the favorable structure itself and has demonstrated the actual presence of petroleum can one begin to calculate the quantity of proved reserves for any oil field.

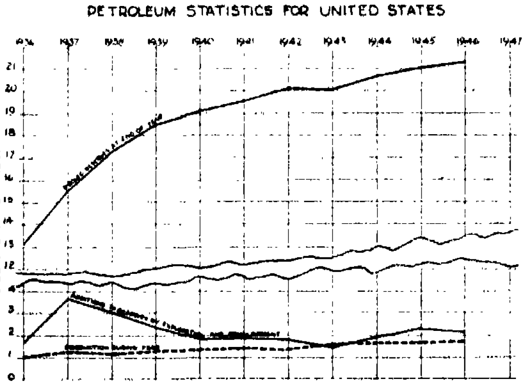

FIG. 3. Relation of petroleum production to proved reserves, United States, 1936–46.

The relation between proved reserves and the total supply of petroleum in the ground is best indicated by the history of American oil fields. Almost every minor variant of the geological conditions essential for an oil pool is found somewhere within the extensive petroliferous area of the United States. Accurate records of nearly all drilling operations and of the resulting production of oil and gas are available over a long period of years. American geologists have specialized in the computation of known and probable reserves for each of the many oil fields at various stages in their development, from the drilling of the "discovery well" to the exhaustion and abandonment of the older fields.

The broad picture is indicated in Fig. 3. During the 11 years from 1936 to 1946, inclusive, there has been an intensive search for new oil fields, the results of which have made possible the increase in annual production from approximately 1,000,000,000 barrels in 1936 to nearly 1,750,000,000 barrels in 1946. In spite of the removal of this vast quantity of oil, the proved reserves have been greater at the end of each year than at the beginning, with the sole exception of 1943, when there was a relatively small amount of exploratory drilling because of the limitations upon steel for well-casings, imposed by the necessity of allotting large quantities of steel to ship-building and military equipment. It will be noted, however, that the curve entitled "Proved Reserves at End of Year" rises steeply for only four years, from 1936 through 1939, and thereafter shows a definite tendency to level off. There is little doubt that the peak of that curve will be recorded by 1950 and that thereafter it will descend toward zero.

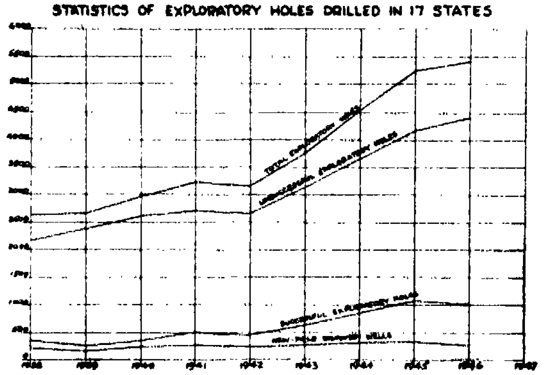

FIG. 4. Results of exploratory drilling in the 17 most important petroleum-producing states of the United States, 1938–46.

This somewhat gloomy forecast is borne out by a more detailed study of drilling operations in the 17 states that include the major part of America's petroleum resources. The essential data are depicted in Figs. 4, 5, and 6. The number of exploratory holes drilled in that area increased from 2,700 in 1938 to 5,400 in 1946, but the number of wells that discovered new fields fluctuated within very narrow limits and was only a little larger at the end of the selected period than at its beginning. Especially disappointing is the fact that there were fewer successful exploratory wells in 1946 than in 1945, although the total exploratory holes drilled in that year was appreciably greater. In spite of the increased expenditure for exploratory drilling, the number of new fields discovered has decreased each year since 1943. Especially significant is the fact that the number of major fields (confidently estimated to contain over 10,000,000 barrels of oil each at the start of drilling operations) has decreased steadily since 1940. There is no doubt that in this area nearly all the large oil pools have now been located, and with rare exceptions only small pools containing only a few million barrels await future discovery. Inasmuch as many of the more recent exploratory wells are deep tests, the more accurate presentation of results is expressed not by the simple number of holes drilled but by the relation between the number of feet drilled in exploratory holes and the number of barrels of oil discovered by the successful holes. The curve in Fig. 6, entitled "New Proved Reserves per Exploratory Foot Drilled," tells the story with impressive solemnity. Its decline from 1938 to 1946, compared to the increase in production from this 17-state area during the same years, is the crux of the problem and fully justifies the gloomy prediction with which the preceding paragraph was closed. This, of course, is the inevitable story for every oil-producing region in the world. Although for a time a locality or a nation may profit greatly from the rich stores of oil within its bounds, sooner or later those stores will be exhausted. We are dealing with a nonrenewable resource. We are burning up the capital provided by nature.

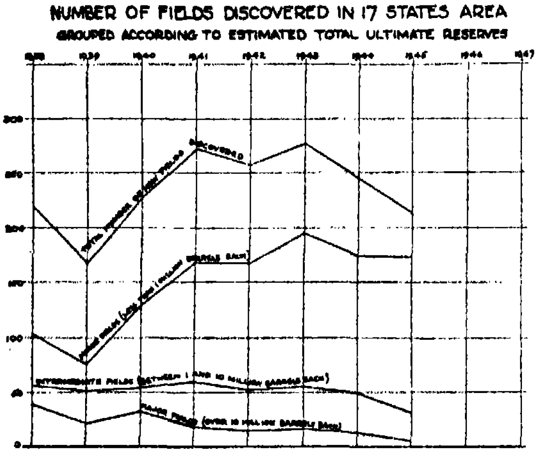

Fig. 5. Statistics concerning new oil fields discovered in the 17 most important petroleum-producing states of the United States, 1938–45.

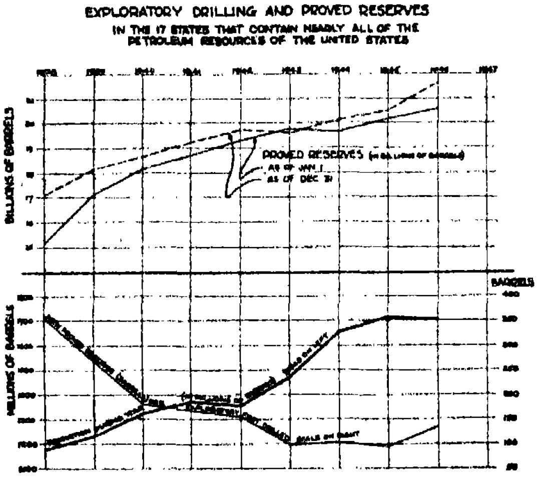

Fig. 6. Results of exploratory drilling for oil in the 17 most important petroleum-producing states of the United States, 1938–46.

The United States is now enjoying the greatest petroleum production of all time. It is a safe expectation that the actual reserves of oil beneath its surface are two or three times the proved reserves of 20,000,000,000 barrels, but it is equally probable that its domestic production will fail to meet its needs within 5 or 10 years from now. Production will probably be maintained at levels far above 1,000,000,000 barrels per year for 25 or 30 years to come, but even such quantities will not be adequate to meet the steadily increasing demands.

Although we are prone to think of petroleum largely in terms of gasoline and diesel oil for internal combustion motors and of fuel oil for heating our homes and operating steam engines, the fact is that many other uses are now increasing the consumption of this most flexible of liquids. Not only are American farmers using power machinery to a larger extent as the years go by, but they are also using petroleum derivatives for insecticides and fungicides and many other purposes. Synthetic rubber, based upon butadiene derived from petroleum, is a wartime development, but it is here to stay. At many an oil refinery the butadiene storage tanks bulk large against the maze of pipes and towers.

Faced by this prospect of increasing demands and dwindling supplies, petroleum geologists, engineers, and economists must employ every weapon in the arsenal of science and technology to meet the situation. Every barrel of oil brought to the surface must be used as effectively as possible. Much progress has been made in the last few years in the development of such refinery techniques as catalytic cracking, alkylation, and the fractionating of the lighter compounds in the mixture of hydrocarbons comprising every crude oil. Research continues to blaze the trail toward the most efficient use of natural resources, always an important aspect of their conservation.

At the same time, every effort must be made to insure the maximum production from the dwindling reserves. This involves two factors. First, there is the increase in percentage of recovery from pools, after they have been discovered, by improved methods of production, such as maintaining the optimum gas-oil ratio throughout the life of a well, and by using such methods of secondary recovery as the water drive and repressuring by gas injection. Second, there is the discovery of new pools, either in new localities or by deeper drilling in old fields. This is the function primarily of the petroleum geologist and involves continuing research as well as the application of procedures already well established by long practice.

The importance of geology and geophysics is now well recognized throughout the entire industry in the United States, if not also in every other country. The statistics pertaining to the exploratory wells drilled in the United States in 1943 may be cited as illustrative of the reasons why geologists and geophysicists have established a secure place for themselves and may expect to continue their activities in the search for petroleum for many years to come. In that year 3,843 exploratory wells were drilled. The location of 3,242 of these is known to have been selected on the basis of geological or geophysical surveys, or a combination of the two. Of these scientifically located wells, 626 proved to be productive—that is, approximately 20 per cent were successful. Of the remainder, 523 are known to have been located by nontechnical methods. Only 23 of these or less than 5 per cent, were successful. The method of determining the location of the other 78 wells is unknown; 6 of them were productive.

It is not to be expected, however, that this excellent record of geological and geophysical achievement can be maintained in future years. Less favorable locations must be tested with the drill, if every oil pool, no matter how small, is to be discovered. A smaller percentage of successful wells to total exploratory tests is inevitable as the search becomes concentrated upon stratigraphic traps and the doubtfully effective structural traps.

Accepting the fact that almost all the large oil pools within the land area of the United States have by this time been discovered, attention at the moment is being given to the possibilities of oil production from the submerged portion of the continent, known to geologists as the continental shelves. The Coastal Plain of Louisiana and Texas continues far out beneath the waters of the Gulf of Mexico, and the present position of the shoreline has no relationship whatsoever to the occurrence of oil beneath its surface. From the standpoint of geology there is no reason to doubt the presence of salt domes beneath the marginal waters of the Gulf, quite similar to those beneath the adjacent shore.

Petroleum engineers have already had considerable experience with drilling operations in shallow water. Hundreds of wells have been drilled in Lake Maracaibo, Venezuela, near its eastern shore. But off-shore drilling in the Gulf of Mexico is a very different proposition from that in the quiet waters of Lake Maracaibo close to shore. Drilling platforms must be high enough above the water to escape damage from storm waves, and out in the open waters of the Gulf where hurricanes occur almost every year, that means a height of at least 30 feet above high-tide level. The engineering problems involved in constructing stable bases for drilling operations are obviously very difficult.

Surveying techniques to determine favorable drilling sites depend largely upon the portable seismograph and the gravity meter. Adaptation of their use for underwater surveys has been greatly facilitated by certain of the ingenious devices developed for military purposes during the war. Similarly, radar has proved most satisfactory for precise location of points occupied by the surveyors—an extremely difficult operation when one is out of sight of land.

In spite of all the difficulties, two wells have already been completed off the Louisiana shore, one 5 miles, the other 30 miles, from land. The former, although drilled to a depth of 12,786 feet, failed to produce oil. The latter encountered the crest of a salt plug at a depth of 2,613 feet, thus verifying the interpretation of the geophysical survey, as a result of which the drilling site had been selected, but at last reports it, too, had failed to encounter commercial amounts of oil. Other wells are even now in various stages of preparation or drilling at distances of 10–40 miles from land. Similarly, among the Bahama Islands and elsewhere on the continental shelf bordering the south Atlantic states, surveys have been in progress for nearly two years, and drilling operations are scheduled to begin at an early date.

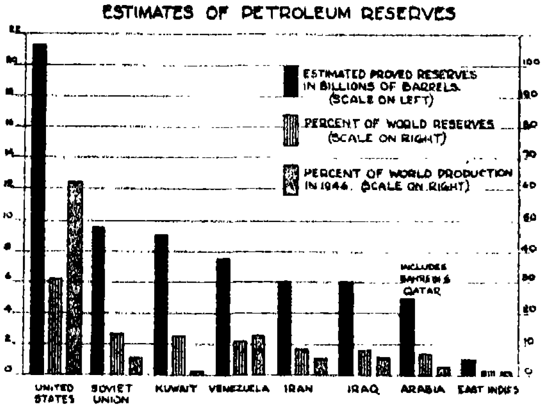

FIG. 7. Petroleum reserves and 1946 production of oil in 8 countries, each of which is believed to have possessed more than 1,000,000,000 barrels of proved reserves on January 1, 1947.

This extension of the search for oil to the continental shelf may confidently be expected to add a few billion barrels to American reserves, but at best it will postpone by only a few years the time when American production will lag far behind American consumption of petroleum products. It is therefore appropriate to look next at the prospects for meeting the future needs of America by importing oil from other countries.

As shown in Fig. 2, American interests control 75 per cent of the nearly 9,000,000,000 barrels of proved reserves in South America, more that 40 per cent of the 26,000,000,000 barrels of proved reserves in the Middle East, and nearly 30 per cent of the 1,400,000,000 barrels of proved reserves in the Far East. Thus, if political factors are favorable, the United States may draw upon nearly as many barrels of foreign oil reserves for its domestic needs as are presently available within its own boundaries.

But the United States does not exist in a geographical vacuum. It is but one among many nations having needs and rights with respect to petroleum. It is therefore imperative to consider this reserve from a world point of view. The broad features of the world picture are shown in Fig. 7, based upon the best estimates of proved reserves made by competent geologists as of January 1, 1947. In all probability, such a graph portraying conditions 10 years hence would show a decrease in the proved reserves for the United States and an increase for every other country, with the possible exception of Venezuela, inasmuch as discovery and development have already advanced so much further in the States than elsewhere. One could almost venture the guess that, whereas the actual reserves beneath the United States are probably not much more than twice the amount shown as proved reserves, in the other countries they average at least three times the amounts shown for them.

Most amazing is the position of Kuwait, the tiny country at the head of the Persian Gulf, exceeded only by the United States and the Soviet Union in the volume of its proved reserves of petroleum. I am, however, assured by Mr. E. L. DeGolyer, who has studied the petroleum potentialities of the Middle East at close range, that the estimate of 9,000,000,000 barrels for that country is very conservative. Significant also are the positions of Iran, Iraq, and Arabia as the fifth, sixth, and seventh countries of the world, when the nations are listed in the order of their petroleum potentialities.

The most important inference, however, that should be drawn from this picture is based upon a comparison of the two percentage columns shown for each country. Whereas the United States possesses only a little more than 30 per cent of the world reserves, its production has been running well over 60 per cent of the world production each year. Venezuela is the only other country, possessing more than 1,000,000,000 barrels of proved reserves, in which the percentage of world production in 1946 exceeded the percentage of world reserves. The deduction is obvious: if present trends continue, 10–20 years from now the United States will be a "have-not nation" so far as petroleum is concerned; the "have nations" will be the Soviet Union, Kuwait, Iran, Iraq, Arabia, and the East Indies. It is no accident that practically all of the potential oil fields of the 5 last-named countries are under the control of American, British, and Dutch corporations.

This raises the question of the adequacy of the world's supply of oil for meeting the future world demands for petroleum products. At the moment, world consumption of petroleum is running at an annual rate of approximately 2,800,000,000 barrels. That is 4 per cent of the world's proved reserves and something like 1 per cent of the world's actual reserves. Demands are certain to increase greatly in the next few years, not so much as a result of increase in world population, but because of increased consumption by people who have not hitherto been large consumers of petroleum products. Whereas, for example, the annual peacetime consumption of petroleum within the United States is 450 gallons per capita, in the United Kingdom it is 80 gallons, in the Soviet Union, 50 gallons, and for the world as a whole, other than the United States, it is only 15 gallons per capita. This marked disparity is certain to be reduced in the future by a great increase in the per capita consumption of petroleum products outside the United States.

Even so, it would appear that world petroleum reserves are quite adequate to meet world needs for half or three-quarters of a century to come. But to use those reserves in the most efficient way, there must be almost complete freedom for distribution of the oil and its products from the regions of supply to all parts of the world, regardless of political boundaries. Never was there more convincing evidence of the fact of mineral interdependence in the modern world, a fact that should be thoroughly comprehended by every person concerned with international relations. In all probability, the optimum distribution of the abundant, but locally concentrated supplies of petroleum can best be attained by some sort of voluntary allotment or quota system, established and maintained by agreements among the nations and corporations possessing and controlling the sources of supply and the means for discovery, extraction, and transportation of the oil.

There are, however, two reasons why alternative sources of gasoline, diesel oil, fuel oil, and lubricants are even now being sought. One is the fear that political and economic barriers may be raised against the free flow of oil from South America and the Middle East to the United States a few years hence, when American production fails to meet American needs. A variant of that fear is probably present in Great Britain, stemming from the contemplation of British dependence upon foreign oil fields and the possibilities of a future war. Despite the superb ingenuity responsible for the discovery of the small oil fields in Nottinghamshire, there is absolutely no possibility of finding sufficient oil in the British Islands to meet more than a very small fraction of Britain's needs. The other reason is the fact that it is by no means too early to begin preparing for the inevitable day, which may come even before the end of the present century, when world production of oil will be inadequate for world needs.

Already, an appreciable fraction of American requirements for petroleum products is being met by the synthesis of liquid hydrocarbons from natural gas. At the moment, a pilot plant for the synthesis of petroleum from oil shale is being completed and put into operation in Utah by the U.S. Bureau of Mines. Methods of synthesizing petroleum products from coal, developed by German scientists before and during World War II, are being checked and improved in the research laboratories of governmental bureaus and private corporations in the States. The success of the oil-shale industry in Scotland and the great quantity of synthetic gasoline that helped so materially in providing power for the German war machines are sufficient guarantee that science and technology have provided an alternative source of supply, long before the petroleum resources of the world have even begun to approach exhaustion.

These alternative sources are almost unbelievably abundant. In the United States alone, there is enough oil shale and coal available to provide the equivalent of 2,000,000,000 barrels of crude oil each year for at least 1,000 years. Similarly, if known techniques of producing petroleum products from coal by chemical synthesis were applied to the coal reserves of Great Britain, all British requirements for such products could be met for at least a few hundred years.

But such application of technical knowledge is not by any means an easy and simple matter. Processes now available are too expensive to permit competition with natural petroleum products except under extraordinary conditions, such as those that make the Scottish and Swedish oil-shale industries economically feasible. The necessary equipment is extremely complicated, very costly, and requires extensive plants. Its installation is not yet practical on a sufficiently large scale to permit such a substitution of mineral fuel sources in the immediate future.

Nevertheless, there is every reason to expect the gradual replacement of natural petroleum products by synthetic products in the more distant future. As the supplies of crude oil are exhausted, this alternative source will take their place. Thanks to science and technology, the mineral fuels stored within the earth will prove adequate for all human needs for as long a time as they are needed. Long before the oil-shale and coal are exhausted, still other sources of energy, such as the atomic energy released by nuclear fission, will be available to do the work that men want done.

Far more difficult than the technical problems involved in meeting the physical needs of humanity are the psychological and spiritual problems that retard the process of learning how to live properly in a world community. Perhaps knowledge of the fact that our small world is a world of potential abundance but inescapable interdependence, as illustrated by such an enquiry as this concerning one typical, nonrenewable resource, may help to accelerate that learning process.

Acknowledgements: I am deeply indebted to R. G. Watts of the Magnolia Petroleum Company, W. H. Wilson of the Humble Oil Refining Company, George Krieger of the Ethyl Corporation, and Roy Stryker of the Standard Oil Company of New Jersey for information and photographs used in the presentation of this paper as an illustrated lecture. The data pertaining to proved reserves of petroleum in countries other than the United States are based upon statistics published in the 1947 edition of the Petroleum Report prepared by DeGolyer and McNaughton. The record of drilling operations in the "17-state area" of the United States was compiled by F. H. Lahee and his Committee on Exploratory Drilling, of the American Association of Petroleum Geologists.

UNESCO Initiates Cooperation in the Abstracting of Biological and Medical Sciences

Eileen R. Cunningham
Vanderbilt University School of Medicine

A QUESTION OF INTEREST TO SCIENTISTS and physicians was the subject of a Conference on the Coordination of Abstracting Services for Medical and Biological Sciences, held by UNESCO in Paris, on October 3, 4, and 5.

The group of interested experts who gathered at UNESCO House were told by Dr. Julian Huxley, the director-general, in his address of welcome, that coordination in this important field was of importance in helping to remove barriers to the free dissemination of scientific ideas and information and, therefore, pertinent to international understanding. He also believed that coordination is important for the abstracting systems of all fields of knowledge.

Dr. Joseph Needham, director of the Natural Sciences Section, discussed some of its activities and stressed the importance of good abstract services for people working in remote parts of the world—for example, in China. Dr. I. M. Zhukova, medical counselor of the Natural Sciences Section, reviewed the events which finally culminated in the Conference. She pointed out that comments in the *British Medical Journal*, the report and recommendations of a committee of the Medical Library Association (USA) based on its recent study of the abstracting of medical literature, communications from the National Research Council (USA), and letters from Dr. John E. Flynn, editor of *Biological Abstracts*, had all served as an inspiration to call a discussion group together.

Dr. Hugh Clegg, editor of the *British Medical Journal*, was appointed chairman of the Conference, and Mrs. Eileen R. Cunningham, of the Vanderbilt University School of Medicine, president of the Medical Library Association, was named vice-chairman. Others present were Dr. Zygmunt Deutschman, director of Technical

Services of the World Health Organization; Prof. W. P. C. Zeeman, an editor of *Excerpta Medica*; Prof. Samson Wright, of the British Bureau of Abstracts; Dr. John E. Flynn, editor of *Biological Abstracts*; Dr. G. M. Findlay, editor of *Abstracts of World Medicine*; Mr. Edward J. Carter, of the UNESCO Libraries Section; other representatives of *Excerpta Medica*; and experts from the UNESCO Secretariat.

The major theme of the Conference was how to provide scientists and physicians with an adequate abstracting service at the lowest possible cost.

The National Research Council and the Medical Library Association were in agreement that amalgamation of existing nonprofit abstracting agencies on an international basis and the elimination of wasteful duplication were goals which were earnestly to be striven for. It was also obvious that this arrangement could probably not become effective immediately; therefore, at least for the present, abstracting will have to be done by existing agencies with some unavoidable duplication. The Conference discussed at length ways of effecting collaboration between the various services on an experimental basis to see what may be accomplished.

The Conference passed some important resolutions and recommendations, and its objective was stated clearly by the first resolution:

> It is desirable, on a cooperative basis, to provide a scientific medical information service by means of abstracting current publications at the lowest possible cost to the consumer.

Further discussion made it clear that, in order to be effective, this would have to be done on a nonprofit basis as far as is consistent with self-support. An interesting development was the statement by *Excerpta Medica*'s representatives that they would undertake investigation of methods of operation on a nonprofit basis.

Many of the terms used in connection with abstracting were thought to require clearer definition. Just what was meant by a "comprehensive" service came up for discussion, and it was decided that "a comprehensive abstracting service in the sense of abstracting all articles of all journals is impossible and undesirable," but comprehensiveness, in the sense that such a service would *survey* the whole of the world medical literature, would be imperative. Discussion brought out the fact that, of late, hardly a science exists in which some of the work reported does not occasionally have significance for clinical medicine. Collaboration with abstracting services in the nonmedical sciences was therefore considered of the utmost importance in order to obtain their aid in drawing the attention of the editors of clinical abstracting journals to such publications. It was also felt desirable that abstracting services intended for the practitioner as well as for the investigator should cover literature at a world level rather than, as they frequently do at present, cover literature chiefly at the national level or only work published in English.

The question of the content and scope of an abstract was discussed and it was concluded that:

> An abstract should give enough information to the reader to enable him to decide whether he should consult the original article abstracted and should include the principal data of the article. . . .

This is especially important for scientists working far from large libraries who must depend to a great extent on film services for access to original articles. It was also thought desirable that an abstract should indicate if the work is of interest to several groups, e.g. physiologists, chemists, clinicians, and should be as short and concise as is consistent with furnishing this information.

Duplication of specialists' abstracting journals was regarded as undesirable.

Excerpta Medica was asked to consider discontinuing those special sections already covered in *Biological Abstracts* and elsewhere. It was also recommended that *Biological Abstracts* should consider revising its subject scope with a view to excluding material appropriately covered by other organizations, and it was suggested that *World Abstracts* (British) collaborate with *Excerpta Medica* in regard to the specialists' section.

It was suggested that UNESCO undertake to explore the existing need for various language editions of the comprehensive service and to promote the preparation and publication of comprehensive multilingual dictionaries in the biological and medical sciences.

While there were points of disagreement—for example, on the merit of "authors'" abstracts versus the "critical" abstract—the Conference felt that the value afforded by two days of free discussion was so great and so much progress had been made that a resolution was passed recommending and urging that an "Interim Coordination Committee on Medical and Biological Abstracting" be set up under the auspices of UNESCO, which would function as secretary and convener of the committee meetings.

In addition to representatives from the abstracting services which would be limited to nonprofit organizations, doing extensive abstracting international in scope, it was recommended that representatives from the World Health Organization, the International Federation of Documentation, the International Federation of Library Associations, and the Medical Library Association be included. It was stressed throughout that the needs of the consumer must be considered and that later the Committee could be enlarged if desired.

Because it was realized that this whole program has a bearing on the problem of the abstracting of the literature in other disciplines, it was decided to call the Committee "Interim," and in outlining plans, the possibility of later fitting them into a more extensive program would be carefully kept in mind. A Committee of Experts on Abstracting Services for the Natural Sciences as a whole will probably meet during the coming year, and the possibility of a World Conference on Abstracting is also being considered by the Libraries Section of UNESCO. The Conference felt that work on coordinating the abstracting of biological and medical sciences should go forward without waiting for the larger conferences, and that any data obtained through this Committee would be useful to the contemplated conferences and should be made available so that the members could utilize that experience.

All delegates made it clear that they could not at this stage commit their organizations to definite action, but all will report on the recommendations made to see how far it will be possible to proceed, on an experimental basis, toward effective cooperation. Practical difficulties exist, and it will be important to see if they can be overcome. It was pointed out that, since abstracting services are being criticized for their wasteful duplication, every effort toward coordination should be made with a view to extending knowledge and not duplicating work.

World health is basic to world well-being, and the facilitation of the dissemination of ideas and information in the biological and medical sciences is vitally important to physicians and scientists who have the task of achieving it. UNESCO, working jointly and in cooperation with other organizations, can act as an important factor in breaking down the barriers which result from the isolation of ideas and information at the national level. The results achieved represented adjustments and willingness to cooperate evidenced by all participants. It is to be hoped that the Conference in Paris has laid the foundation for constructive thinking and progress in medical abstracting. The achievements which have been made will require continued interest and support.

Obituary

Hubert Lyman Clark

1870–1947

Hubert Lyman Clark, curator of Marine Invertebrates, emeritus, at the Museum of Comparative Zoölogy and associate professor of zoology, emeritus, of Harvard University, died in the Mount Auburn Hospital, Cambridge, Massachusetts, July 31, 1947, after a short illness.

Following early natural history studies dealing with butterflies, birds, and reptiles, he devoted the greater part of his life to the study of echinoderms and became one of the world's leading authorities on that group of animals.

He was born in Amherst, Massachusetts, January 9, 1870. His innate interest in natural history was stimulated by his father, William S. Clark, who was a student of the natural sciences, president of the Massachusetts Agricultural College, and founder of the Imperial College of Agriculture at Sapporo, Japan.

After publishing two papers on the butterflies of Amherst, the first when he was 13 years old, Hubert Lyman Clark turned his attention to birds and avidly continued these ornithological studies while at Amherst College, from which he was graduated in 1892. With the intention of making these studies his life work, he entered Johns Hopkins University as a graduate student in 1894. There, W. K. Brooks, whom Clark has characterized as "the greatest teacher I have ever known," quickly convinced the young ornithologist that there were other animals in the world besides birds. The interest in marine animals which Prof. Brooks imparted to his student was intensified during a field trip to Jamaica in 1896, when Clark saw for the first time the brilliant colors and varied forms of tropical sea stars, sea urchins, brittle stars, and sea cucumbers. This experience firmly established the study of echinoderms as his major pursuit from that time on.

During this trip to Jamaica he contracted yellow fever and was the only one of six victims of the disease to recover. Although this attack in no way impaired his general health, it did leave him with impaired hearing which made difficult the contact with people he so enjoyed. This affliction in no way affected his friendly disposition, however, or ever caused him to doubt that he was more than usually blessed with good fortune throughout his life.

After receiving his doctorate from Johns Hopkins in 1897, he spent two years at Amherst College as instructor in biology. In 1899 he was appointed professor at Olivet College and, in the same year, married Frances Lee Snell, who, although not a trained biologist, assisted him on many of his later collecting trips and made color sketches from life of many of his discoveries as a guide for the color plates which enhance his more important publications. In 1905 he accepted the invitation of Alexander Agassiz to join the staff of the Museum of Comparative Zoölogy. On only two subsequent occasions was he to return to the classroom, in 1929 as acting professor at Williams College and in 1936 as acting associate professor at Stanford University. After the death of Mr. Agassiz in 1910 he was appointed curator of Echinoderms and in 1927 curator of Marine Invertebrates and associate professor of biology. He held the latter position until he reached the retirement age in 1935 and continued as curator until August 1946. Hubert Lyman Clark's entire background and character fitted him for the teaching profession, but when deafness interfered with this calling he loved so well, he became an excellent museum curator with one of the best-arranged and richest collections of echinoderms in the world to his credit. After his retirement as curator in 1946 he accepted an offer to work on the large collections at the Allan Hancock Foundation in Los Angeles and spent the winter and spring bringing his report on this material to completion. He enjoyed his usual good health during most of this period, and not until just before his departure for Cambridge and a well-earned rest at his summer home in New Hampshire was there any indication of his final illness.

His well-developed wanderlust and his belief in supplementing the study of preserved material with observations on living animals made him ever ready to journey to any region that promised good collecting. A lover of all sports, he considered collecting the greatest of them all. In addition to collecting extensively on both coasts of the United States, he visited Jamaica five times, Bermuda twice, Tobago, the west coasts of Central and South America, and the Galapagos Islands, Australia three times, and China and Japan. His trips to Australia in 1913, 1929, and 1932, during which he collected along most sections of the coast of that continent, furnished him with the material for his important studies on the echinoderm fauna of Australia.

His publications, in addition to the earliest ones on butterflies alluded to above, included more than 20 on the distribution, variation, anatomy, and pterylography of birds. Even as late as 1945 he published a paper on the feather tracts of certain Australian birds and renewed his plea for greater recognition of this branch of ornithology. While he was at Olivet College he became interested in the reptiles and amphibians of Michigan and published six papers on these studies. More than 100 publications on echinoderms, many of them of a monographic nature, serve as his monument to individual research in an era when an able scientist, unhampered by extensive administrative duties, could let his conscience be his guide. These volumes cover material from most of the outstanding museums and expeditions of the world and reach a fitting climax in his monographs on the Australian fauna. In addition to these technical publications, several of a general biological nature and several more covering his sociological and philosophical outlook have appeared.

In 1927 he was awarded an honorary degree of doctor of science from Olivet College and in the spring of 1947, a few weeks before his death, he received the Clarke Memorial Medal for his service to Australian science.

ELISABETH DEICHMANN
Museum of Comparative Zoölogy, Cambridge, Massachusetts

FENNER A. CHACE, JR.
U. S. National Museum, Washington, D. C.

NEWS *and Notes*

This year, for the first time in its history, the Association has been able to print and mail its General Program to those who registered well in advance of its annual meeting. More than 1,500 copies of the Program of the Chicago Meeting a book of 340 pages listing more than 2,000 papers, were mailed from the Washington office during the first week in December. All applications accompanied by registration fees received after December 15 are being held and placed on file at the Information Booth in the Stevens Hotel, where they may be obtained for registering during the meeting.

A major problem in the preparing the General Program is to obtain complete copies of all the individual programs of the 67 sections and societies in time to permit editorial revision and printing at least three weeks in advance of the meeting. It is desirable that the programs be mailed early in December to avoid delays in handling mail that result from the heavy Christmas volume.

Advance distribution of the Program makes it possible for the registrant to plan the most economical use of his time during the convention. It is also a help to those who, until they have some knowledge of the papers to be presented, are uncertain whether they will attend the meeting. Moreover, early publication frees administrative personnel so that they may turn their attention to the many other local arrangements which must be completed during the two weeks immediately preceding the meeting. For example, the final weeks are critical in completing public-feature arrangements, particularly radio broadcasts based largely on selections from the General Program by specialty directors of national networks and local radio stations. Times for network programs are scheduled several months in advance, but the panels of speakers are often drawn up two weeks, or less, in advance of the meeting.

In order to ensure that the General Program shall be off the press according to schedule, it is necessary to set the deadline for the receipt of program copy 4–6 weeks in advance of the publication date. If the secretaries are to meet the Association's deadline, they must undertake to organize their own programs several weeks earlier. Although the secretaries of most societies are able to meet the deadline, actual printing of the General Program is delayed until the last minute to obtain programs of late-reporting secretaries. Then commences a headlong rush to meet the publication date.

Early this year a general announcement was sent to the secretaries of the sections and societies, giving the schedule of deadlines to be followed in preparing for the Chicago Meeting. The deadline for the receipt of copy for the General Program was set at October 21. On September 26 follow-up form letters were mailed, including examples of how the copy should be typed to conform with the standard format adopted for the Program.

The first manuscript copy for the General Program arrived a few days before the deadline, and the last program material accepted for publication was received on November 24. Every consideration was given to secretaries harassed by unavoidable delays. Only when it became apparent that the Program had to be completed in a matter of hours in order to have bound copies available for mail distribution on December 1 did the staff set aside last-minute requests for the inclusion of supplementary material. Corrections were made until the moment the presses began rolling. From October 21 through November 24, there was a constant exchange of manuscripts, galleys, corrected and recorrected proof.

Signatures of 16 or 32 pages are made up as soon as the galleys of type have been arranged into page form and numbered. It is, of course, impossible to assign page numbers to the various programs of the sections and societies until they have all been received and set in galleys. The last manuscript of the Chicago Program to be received belonged in the middle of the book and delayed the paging of all the remainder until after it was set in type.

The combination of printing separate signatures and making last-minute corrections sometimes leads to obvious inconsistencies. For example, last-minute corrections in the spelling of names on the programs may be caught in the Index, but cannot be change in the earlier printed signatures.

Publication of the General Program is an important part of the meeting arrangements, but it is by no means the most difficult. The problems of scheduling meeting rooms for 67 sections and societies, contracting for equipment and operators of projection apparatus, arranging and directing registration, entertainment, and publicity are equally formidable. The costs for providing these services run into many thousands of dollars. Those who attend the meetings of the Association are therefore urged to register, not only to obtain copies of the General Program, but to help meet the heavy expenses incurred to provide facilities for their benefit.

Members who do not attend the AAAS Meeting in Chicago may tune in on several radio programs scheduled during the convention period. On Friday evening, December 26, Harlow Shapley, president of the AAAS, will be interviewed on the well-known radio broadcast, "Meet the Press." The program is scheduled at 10:00 P.M. (E.S.T.) and may be heard over the network of the Mutual Broadcasting System.

A number of programs have been scheduled on Sunday, December 28. At 11:30 A.M., the Northwestern Reviewing Stand, carried by the Mutual Broadcasting System, will feature "Atomic Energy and Peace." K. Lark-Horovitz, general secretary of the AAAS, Philip Powers, adviser on scientific personnel, U. S. Atomic Energy Commission, and Walter Zinn, director of the Argonne National Laboratories, Chicago, will constitute the panel of speakers.

At 1:30 P.M. on Sunday, December 28, the National Broadcasting System will carry the Chicago Round Table of the Air. James B. Conant, president of Harvard University, George Stoddard, president of the University of Illinois, and Robert Redfield, Department of Anthropology, University of Chicago, will discuss "Prospects for the Scientific Study of Human Relations."

The Columbia Broadcasting System is preparing special AAAS coverage this year, not only of significant and interesting research reports but also of programs designed to place the social implications of science before the public. The following programs will be devoted to the meeting (E.S.T.): "Adventures in Science," Saturday, December 27, 4:30 through 4:45 P.M.—a news interview program conducted by Watson Davis of Science Service. "In My Opinion," Monday, December 29, 6:15 through 6:30 P.M.—a special CBS discussion series under the direction of George Crothers, of the Division of Education, Columbia Broadcasting System. "Frontiers of Science," Tuesday, December 30, 11:30 through 11:45 P.M.—general news, reports, and comments about the meeting. If circumstances permit, other 15-minute programs will be assigned daily at either 6:15 through 6:30 P.M. or 11:15 through 11:30 P.M.

One of the most interesting features of the broadcasts arranged by CBS will be a general coverage of society meetings and interviews with prominent scientists obtained by means of magnetic tape recordings, which will be edited and rebroadcast during the 15-minute intervals allotted by the network.

Other radio programs not mentioned here have been tentatively arranged. Undoubtedly, impromptu broadcasts, featuring special fields of science, will be made during the meeting under the auspices of the local broadcasting stations.

Organization of a new Society for the Social Study of Invention will be considered at the Chicago Meeting of the AAAS. As part of the program of Section K, a meeting will be held for this purpose in Room 105 of the Sherman Hotel on Tuesday morning, December 30. The proposed field for such a society would encompass the social effects of invention, the social causes and controls of invention, including the patent system fundamentally viewed, the psychology of invention, and the history of invention. Economists, sociologists, physical scientists, engineers, inventors, patent attorneys and officials, psychologists, and historians will all be interested in the formation of such a group. The Organizing Committee includes W. F. Ogburn, Department of Sociology, The University of Chicago, as chairman pro tem; Waldemar Kaempffert, science editor of the *New York Times*; Joseph Rossman, Washington, D. C.; Robert K. Merton, Columbia University; J. W. Oliver, University of Pittsburgh; and J. B. Gittler, Iowa State College. Watson Davis, of Science Service, Casper W. Ooms, recent Commissioner of Patents, and W. A. Hamor, of the Mellon Institute, will act as special advisers.

About People

Harlow Shapley, director, Harvard College Observatory, and president of the AAAS, has been elected an honorary foreign member of the Italian Academy of Lynxes. Since its founding in 1603 the Academy has been Italy's leading general scientific organization. **Ross G. Harrison,** Yale University, and **Arthur H. Compton,** Washington University, are the two other American members.

Theodore E. Boyd, Loyola University School of Medicine, Chicago, has been appointed to the newly created position of associate director of research, National Foundation for Infantile Paralysis, New York. Dr. Boyd will collaborate with **Harry M. Weaver,** director of research, in coordinating the Foundation's program of study into the cause, control, and treatment of poliomyelitis and allied virus diseases. The Foundation has authorized $6,953,256.66 for such research since 1938.

Henry Augustus Pilsbry, curator of mollusks and other invertebrates, Academy of Natural Sciences, Philadelphia, was honored on his 85th birthday, December 8, at a meeting of the Academy. Dr. Pilsbry, who joined the Academy staff 60 years ago, is now completing an exhaustive monograph on "The Land Mollusca of North America."

Charles H. Brown, associate director, Iowa State College Library, and **Verner W. Clapp,** assistant Librarian of Congress, have left for Tokyo, at the invitation of Gen. MacArthur, to aid in setting up a National Diet Library similar to the Library of Congress. Dr. Brown will also visit China as a representative of the American Library Commission and chairman of the Association's Committee on the Orient and Southwest Pacific, which he has headed since 1942, to arrange for a series of library institutes in China during 1948.

Cecil J. Watson, professor of medicine, University of Minnesota, served as physician-in-chief pro tempore at the Peter Bent Brigham Hospital, Boston, from October 26 to November 1. While there, he delivered the E. Stanley Emery, Jr., Memorial Lecture on "Porphyria and Porphyrinuria: An Enlarging Concept of the Porphyrins in Clinical Medicine."

Titus C. Evans, Department of Radiology, College of Physicians and Surgeons, Columbia University, has been appointed research professor in radiology and radiobiology, and head, Laboratory of Experimental Radiations, College of Medicine, State University of Iowa. Dr. Evans will go to Iowa City on or about January 1.

Oscar F. Weber, a member of the College of Education faculty, University of Illinois, for more than 25 years, will soon retire because of ill health.

Lt. Col. Henry B. Webb of the Medical Administrative Corps, and former chief, Department of Bacteriology, Army Area Laboratory, Brooke Army Medical Center, Fort Sam Houston, Texas, is joining the faculty of the Department of Biological Sciences, San Antonio Junior College, in January, beginning with the second semester.

Ford M. Milam, former research assistant in soils and crops at North Carolina State College, was recently appointed coordinator of agricultural education and research under the American Military Government in South Korea, transferring from his previous position as adviser, Agricultural Experiment Stations, in that country. As coordinator, Mr. Milam, who was separated from the AAF in June 1946 as a major, will supervise and determine policy for all activities of the newly established agricultural extension system, the 13 central and branch agricultural experiment stations, and all agricultural schools and colleges in South Korea. The new extension service was originally proposed and outlined by Mr. Milam, who also acted as chairman for the drafting committee which prepared the plan for final approval and legal establishment by the South Korea Interim Legislature.

Visitors to U. S.

Paul L. Dengler, director, Austro-American Institute of Vienna, a director of the Austrian League for the United Nations, and a member of the Austrian Commission for UNESCO, lectured on "Educating World Citizens" at Ohio State University, December 10, under the auspices of the Ohio State Graduate School and the College of Education. Dr. Dengler is touring American colleges and universities under the sponsorship of the Institute for International Education in New York.

Sydney Goldstein, professor of mathematics, University of Manchester, England, and chairman, Aeronautical Research Council of Great Britain, who is currently (December 18–20) giving a series of four lectures at the University of Texas on "The Mathematics of Transonic and Supersonic Airflow," will give a series of eight lectures at the California Institute of Technology, in late December and early January. The series will be of a theoretical nature at an advanced level and will be concerned with recent developments in transonic and supersonic flow with some attention to compressible laminar boundary layers. Dr. Goldstein also delivered the Wright Brothers Lecture at the Institute of Aeronautical Sciences in Washington, D. C., December 17.

Subohd K. Mukherjee, Calcutta University, India, with a recent Ph.D. from Massachusetts Institute of Technology, is a member of the Seagram International Fellowship Program. He is currently engaged in research in Seagram's Louisville, Kentucky, laboratories.

Grants and Awards

The 1947 Nobel Prize awards were formally presented December 10 by King Gustav, at the Stockholm Concert House. Present at the ceremonies were **Carl F.** and **Gerty T. Cori,** St. Louis, Missouri, and **Bernardo Houssay,** Argentina, who shared the award in medicine; **Sir Edward Appleton,** England, winner of the physics award; and **Sir Robert Robinson,** England, chemistry prizeman. Three former prizewinners were also present: **Harold Urey,** 1934 winner in chemistry, and **Joseph Erlanger,** 1944 winner in medicine, both of the United States; and **Gerhard Domack,** German winner of the 1939 medicine award who, because of Nazi disapproval, was unable to accept it. Drs. Urey and Erlanger delivered their postponed Nobel lectures. King Gustav gave a dinner for the winners at the Royal Palace December 11.

Two annual awards for outstanding contributions to aviation medicine have been established by the Aero Medical Association of the United States. They are in memory of Raymond F. Longacre and Theodore C. Lyster, two of the first Flight Surgeons of the AAF, who contributed greatly to the early development of aviation medicine. The Longacre Award for 1947 has been presented to **Ross A. McFarland,** Harvard University, who was also made an Honorary Fellow of the Association, and this year's Lyster Award went to **Louis H. Bauer,** of Hempstead, Long Island.

Donald F. Jones, head, Genetics Department, Connecticut Agricultural Experiment Station, was honored by the Hybrid Seed Corn Division of the American Seed Trade Association at the Division's annual meeting in Chicago on

December 2. Dr. Jones received an award for his "outstanding contribution in suggesting the double cross method in seed production." It was in 1917 that Dr. Jones made the first "double cross" (recrossing two hybrids) at the Connecticut Station, a method which eliminated small, poorly matured hybrid seed, and seed which was too expensive for general use.

Norman W. McLeod, consultant to the Department of Transport in Canada, received this year's Highway Research Board award for an outstanding technical paper. The paper, "Airport Runway Evaluation in Canada," which was given at the Board's 1946 annual meeting, presents formulas to be used in designing airports and highways of the future to withstand extremely heavy loads.

The Sugar Research Foundation of New York has made a grant of $3,000 to the University of Texas Medical Branch, Galveston, for the support of research studies on protection of the liver bicarbohydrate from action of carcinogenic compounds, to be under the direction of W. A. Selle, director, Biophysics Laboratory.

The Fisher Award in Analytical Chemistry has recently been established by Chester G. Fisher, president, Fisher Scientific Company, Pittsburgh. This award of $1,000 and a medallion for outstanding achievement in analytical chemistry, which will be administered by the American Chemical Society, was founded to recognize and encourage important contributions to the science of pure or applied analytical chemistry made in the United States or Canada. Special consideration will be given to independence of thought and originality shown in a candidate's research, or to the significance of the work when applied to public welfare, economics, or the needs and desires of humanity. Nominees may be proposed by any member of the American Chemical Society. Nominations of candidates must be submitted by January 1 to Alden H. Emery, Executive Secretary, American Chemical Society, 1155 16th Street, N.W., Washington 6, D. C.

Mary E. Weeks, head of the translation service of the Kresge-Hooker Scientific Library, Wayne University, has recently been awarded an alumni citation from Ripon College for "outstanding ability and distinguished accomplishment in the field of chemistry." Dr. Weeks, who reads six languages besides English, is the author of *Discovery of the elements*, an associate editor of *Record of Chemical Progress*, official publication of the Library, and consulting editor of the new *Chymia*.

Fellowships

Radcliffe College has available for the year 1948–49 about 50 fellowships, with stipends ranging from $400 to $1,500, open to women candidates for the M. A. and Ph. D. degrees for advanced study under members of the Harvard faculty in the field of the candidate's choice. The larger awards are granted to those who have completed two or more years of graduate work, and preference in granting smaller awards is given to those who have completed one year of graduate work. Several tuition fellowships of $400 are, however, available to students who have done no graduate work, but who present evidence of high scholarship. Applications and a transcript of record should be submitted by March 1.

Colleges and Universities

The Chicago Professional Colleges, University of Illinois, have established a Department of Clinical Science to emphasize the interdependence of the basic sciences and the practice and progress of clinical medicine. The Department, to be headed by **A. C. Ivy,** vice-president of the University, will conduct research in normal and pathological gastrointestinal physiology, involving studies of enterogastrone in the treatment of peptic ulcer, cholecystokinin in the diagnosis of gall bladder disease, and the chemical structure of secretion; the biology of cancer, including studies of diagnostic tests for cancer, and growth-promoting and growth-inhibiting substances; the vital function of the kidneys; involving studies of prolongation of life after bilateral removal of the kidneys, and the mechanisms and most effective means of producing analgesia, involving a search for analgesic drugs and a study of where they act. Assistant professors assigned to the Department include **Morton I. Grossman, William H. Backrach, Louis R. Krasno,** and **L. L. Gershbein;** 5 research fellows and 30 graduate students are also conducting research in the Department. Three courses for graduate students are being offered this semester: Advanced Physiology of the Digestive System, Seminar in Clinical Science, and Research in Clinical Science. For undergraduate medical students there is a course on Physiology of Symptoms.

Applications for graduate assistantships at Oklahoma Baptist University for 1948–49 are now being received. The assistantships, paying between $900 and $1,000 for 9 months of part-time teaching, are open in geology, biology, chemistry, physics, mathematics, and engineering subjects. Students who qualify will be expected to carry graduate work at the University of Oklahoma, Norman. The stipend includes $900, paid to the student in 9 installments, plus out-of-state fees, if any, up to a maximum of $1,000. Other fees at Norman will be paid by the student. Regular transportation is available between the two campuses, 35 miles apart. Applications should be addressed to John W. Raley, president of OBU, Shawnee, and should be postmarked before March 1, 1948.

Elections

Camp Detrick, Frederick, Maryland, has organized a Sigma Xi Club, believed to be the first Sigma Xi Club organized at a governmental research installation. George B. Pegram, dean, Graduate School, Columbia University, and treasurer of the National Society of the Sigma Xi, was the installing officer and the principal speaker. Charter membership of the club consists of 54 members who are alumni of 38 local chapters in 21 states. It is expected that the club will sponsor lectures by outstanding speakers on subjects of broad scientific interest. Officers installed for the coming year are: L. A. Chambers, president; Berch Henry, president-elect; Emily Kelly, secretary; Archie Gorelick, treasurer; R. D. Housewright, Carl Brewer, and Charles Phillips, trustees.

Recent Deaths

Joseph Peter Connolly, 56, president, South Dakota School of Mines and Technology since 1935 and associated with that institution since 1919, died October 7 at his home in Rapid City, South Dakota, after a long illness.

George W. Pucher, 49, biochemist at the Connecticut Agricultural Experiment

Station, New Haven, died suddenly November 20 following a heart attack. During his 19-year association with the Station he had become known for his development of methods for determining various constituents in plants.

Claude Fountain, 68, physicist, Naval Research Laboratory, and former president, Tennessee Academy of Science, died November 28 after a short illness.

George E. Shambaugh, 78, chairman, Department of Otolaryngology, Rush Medical School, and head, Otolaryngology Department, Presbyterian Hospital, died November 30.

Edgar J. Witzemann, 63, professor of physiological chemistry, University of Wisconsin Medical School, died November 30 after a short illness.

Godfrey Harold Hardy, 70, emeritsu professor of pure mathematics, Cambridge University, died December 1 at Cambridge.

Raymond Harman-Ashley, 67, chairman, Department of Chemistry, St. Lawrence University, until his retirement in June, and inventor of the chemist's slide rule, died at his home December 1 after a short illness.

William Pepper, 73, dean emeritus, School of Medicine, University of Pennsylvania, died in University Hospital December 3, of a coronary thrombosis.

David L. Taylor, 31, assistant professor of botany, Department of Botany, University of Illinois, died December 6. Dr. Taylor joined the Illinois staff in September.

Make Plans for—

Northwest Scientific Association, December 26–27, Davenport Hotel, Spokane, Washington.

American Society for Professional Geographers, December 27–30, Charlottesville, Virginia.

Association of American Geographers, December 29–31, Charlottesville, Virginia.

Mineralogical Society of America, December 29–31, Ottawa, Canada.

COMMENTS *by Readers*

We consider it our duty to offer the following information without delay, instead of waiting until we have accumulated enough data to write a detailed scientific report on our findings.

Surface tension measurements of solutions of sodium penicillin were carried out with the du Noüy tensiometer and the pendant drop technique. The results proved that solutions of sodium penicillin in distilled water are highly capillary active. The surface tension of a solution containing 10,000 units of penicillin sodium salt (Abbott)/cc. gave a surface tension of 31.7 dynes/cm.

Since the preparation, at least from a colloid-chemical point of view, must be considered to be composed of a hydrophilic cation and a hydrophobic complex anion comparable to soaps, it seemed only logical to assume that we are not dealing with true solutions, but hydrosols.

We therefore studied this preparation with a slit ultramicroscope. A highly colloidal system with particles ranging between approximately 100 and 500 $m\mu$ could be readily detected. The particles are anisometric, which is clearly evidenced by a very pronounced twinkling phenomenon. To make absolutely sure that this observation was not due to impurities contained in the commercial product used, we obtained, through the courtesy of Henry Welch, of the Federal Food and Drug Administration, a highly purified sodium salt of penicillin (F.D.A. Penicillin/Working Standard/Sodium Penicillin G/Potency 1,667 u/mg.), and dissolved it in triple-distilled water which, by itself, showed not the slightest indication of a Faraday-Tyndall cone. The solution, however, exhibited a very pronounced one, which clearly indicates that we are not dealing with a true solution, but with a colloidal sol.

Surface tension measurements of solutions of highly purified streptomycin calcium chloride complex of varying concentrations gave figures slightly above those obtained with distilled water at the same temperature. The preparation, if studied ultramicroscopically, however, shows very pronouncedly that it is a colloidal sol and not a true solution. The particle size of the dispersed phase averaged 65 $m\mu$. That this sol is not capillary active might be due to the divalent calcium ion and its low degree of hydration. (ERNST A. HAUSER and RUTH G. PHILLIPS, *Massachusetts Institute of Technology*, and LT. (j.g.) JOHN W. PHILLIPS, MC USNR, *Naval Medical Research Institute, Bethesda, Maryland.*)

* * *

Lest some scientist needing a passport be discouraged by Dr. Bok's recent account of his unfortunate failure to obtain a passport within a limited time (*Science*, October 10, p. 341), may I describe a case in which the State Department acted with gratifying speed. One member of my recent Eclipse Expedition to Brazil mailed an application for a passport to Washington on March 25, and the passport was received by mail on April 3. No special telegrams were sent; no pressure was exerted by any government official. It seems to me that 9 days for a routine which normally requires three weeks represents excellent service. (CHARLES H. SMILEY, *Director, Ladd Observatory, Brown University.*)

* * *

The recent report of a study made by Davis and Briggs concerning the growth-promoting action of cellulose (*J. Nutrition*, 1947, **34**, 295) reveals a not uncommon type of error in the design of diets which makes the results of their use questionable. In this study, glucose in the basal diet was replaced by cellulose. If the cellulose served as a source of carbohydrate in the diet, such a substitution would be justified. However, even if the data on "crude fiber" were acceptable as an index of digestibility, they indicate that the cellulose served mainly as an inert material, especially when more than 5 per cent was fed. The replacement of glucose by cellulose therefore reduced the carbohydrate content or increased the proportion of protein, fat, and other constituents of the utilizable part of the diet, and this may explain the results attributed to the cellulose.

A similar error, made by Guerrant and Dutcher (*J. Nutrition*, 1934, **8**, 397), led to the erroneous conclusion that cellulose had a vitamin B and G sparing effect. The replacement of sucrose by cellulose or agar in their basal diet reduced the carbohydrate content of the diet and hence also the vitamin requirements. Since then, Mannering, Orsini, and Elvehjem (*J. Nutrition*, 1944, **28**, 141) tested the effect of cellulose by adding it to their basal diet, and no vitamin sparing effect was found. It may be contended that the addition of purified cellulose to the diet requires an increase of minerals (Harriet Morgan. *J. Amer. med. Ass.*, 1934, **102**, 995), protein, and/or other constituents of the diet to maintain a balance, but the data on this subject are controversial (F. Hoelzel. *J. Amer. med. Ass.*, 1939, **113**, 351) and the greater error appears to be made by simply replacing utilizable nutrients by cellulose.

In short, cellulose should evidently be regarded as an inert or nonutilizable material unless there is evidence that it can be utilized by the species to which it is fed. A loss of "crude fiber" by the passage of cellulose through the digestive tract cannot be accepted as evidence of digestibility. This was indirectly indicated about 25 years ago when "Cellu Flour" was analyzed at the Connecticut Agricultural Experiment Station (Bull. 127, 1921, p. 230). A low "crude fiber" content was found, although this flour proved to be a satisfactory nonnutritive substitute for ordinary or starchy flour in the diabetic diet. The "digestion" of cellulose which is assumed to occur on the basis of "crude fiber" determinations may therefore mainly be a mere modification of the cellulose such as is produced in the manufacture of dietetic cellulose like "Cellu Flour." This modification is not produced by enzymes or bacteria.

It is not intended to imply by the foregoing that cellulose in the diet is of no value. On the contrary, its value for some species may be due chiefly to its relative inertness. In our longevity studies on rats (*J. Nutrition*, 1946, **31**, 363; 1947, **34**, 81), we used a basal or low-residue omnivorous diet and other diets consisting of the basal omnivorous diet and added cellulosic bulk-formers. The results obtained thus far indicate that suitable cellulosic bulk-formers tend to prolong the life span and can apparently do this without a stunting of growth (skeletal size, such as seems to have occurred in rats fed diets including ground No. 300 cellophane by McCay and his associates (*J. Nutrition*, 1934, **8**, 435). The details concerning our study will be reported elsewhere when the study is completed. A source of cellulose should evidently be included in the normal diet for man and other omnivores even if cellulose does not promote growth. (F. Hoelzel and A. J. Carlson, *Department of Physiology, University of Chicago.*)

* * *

I wish to comment on "An Auditory Afterimage," by Rosenblith, Miller, Egan, Hirsh, and Thomas (*Science*, October 10, pp. 333–335).

If the curves in Fig. 1, A, are plotted to a log scale of time, they fall on straight lines that have simple equations of the form Duration = a + b log t, where a and b are constants that can be read from the chart. The equations are:

Lower curve, Duration $= -6 + 6\frac{1}{3} \log t$
Upper curve, " $= -9 + 9 \log t$

The symmetry of these constants may be significant.

Attention is called also to an error in Fig. 1, B. The zero point on this log scale is at an infinite distance to the left of the point shown. The ordinate "0" should be 5. (Duff A. Abrams, *801 2nd Avenue, New York City.*)

* * *

The recent article by Stephen S. Visher on "Starring in *American Men of Science*" (*Science*, October 17, pp. 359–361) seems constructive and desirable as far as it goes, but perhaps in one minor respect it should go a little further.

Apparently Dr. Visher contemplates a continuation of the policy of restricting the electorate to those previously starred, or to an additional number selected by some small committee who would add "competent experts" to the voting group. If we could rely on the assumptions (1) that substantially all the voters would vote fairly and impartially, (2) that substantially all the voters would take pains to see to it that newly added fields secured fair participation, (3) that substantially all the voters would give at least several hours careful consideration to the formulation of their votes, such a procedure might work fairly well. It is believed that assumption (1) is fully warranted, but that (2) is quite questionable and (3) even more so.

It is submitted that anyone of sufficient standing to be included in the volume at all should be sufficiently mature and well informed to be able to make a constructive contribution by voting, and *therefore it is suggested that a democratic* basis of selection be followed. A tentative outline of procedure might be as follows:

(1) Expand the fields to 5 or 10 times their present number with a brief, succinct definition of any field for which an adequately descriptive title is not found.

(2) Mail a ballot to each individual listed in the previous edition, and to each individual to be included in the forthcoming edition.

(3) Include with the ballot a list of the designated fields, and ask each recipient to designate the field in which he belongs.

(4) Request each voter to vote for a fixed number, say 10, whom he considers *most outstanding in the voter's field*, even though the recipient of the vote is active chiefly in some other fields, and regardless of whether or not the recipient is listed in the volume.

(5) Star as nearly as may be the same percentage in each field. Ten per cent seems a desirable figure.

The fact that newcomers to be listed for the first time in the forthcoming volume will not be known to voters, except by their activities and publications elsewhere, might be said to place a minor handicap on newcomers. To the extent that there is such a handicap, it is believed the handicap is desirable. It will tend to postpone, and perhaps prevent, the starring of the meteoric individual who happens to register some spectacular achievement, but whose record of achievement is not sustained over a period of years. (Donald H. Sweet, *330 South Wells Street, Chicago.*)

* * *

TECHNICAL PAPERS

Effect of the Injection of Glucose Into the Cerebrospinal Fluid

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The mechanism whereby the processes of carbohydrate metabolism are correlated with carbohydrate intake has been a subject of much investigation and discussion. One of the views which has received attention is that a control of insulin output of the islet tissue through the glucose content of the blood is an important factor. The evidence that a mechanism whereby increased amounts of glucose in the blood elicit increased insulin liberation involves the activation of centers within the brain stem is discussed by Macleod (*2*). In general, the experimental procedures which have been employed are of a laborious nature.

Recently, Marinelli and Giunti (*3*) have reported that injections of relatively small amounts of glucose into the cerebrospinal fluid by way of the cisterna magna result both in the dog and in man in a rapid and pronounced fall in glucose content of the blood, followed by a slower return to basal values. Marinelli and Giunti infer that the glucose content of the cerebrospinal fluid represents a direct chemical stimulation upon the glycoregulatory nervous centers, resulting in functional changes affecting the glucose level of the blood. They suggest that the blood-sugar curves look very much like those following insulin administration. If such responses consistently obtain following this procedure, which is easily carried out and which involves the introduction into the body of an amount of glucose so small as to be quantitatively insignificant in relation to the total glucose content of the body fluids, a number of experiments would be made practicable in further elucidation of the problem of regulation of blood-sugar levels.

In an attempt to corroborate the findings of Marinelli and Giunti, 6 normal, docile dogs were selected, and after a fast of 18 hours blood samples were taken. Without the use of an anesthetic, a needle was placed in the cisterna magna, 2 ml. of cerebrospinal fluid was withdrawn, and 2 ml. of a 5 per cent solution of glucose (Abbott's 5 per cent dextrose, pyrogen free) was injected. In each instance it was possible to carry out the procedure without signs of excitement on the part of the animal and without struggling. Blood samples for glucose determinations were taken at 5, 15, 30, 60, and 120 minutes after the glucose injection. Blood-sugar determinations were made in duplicate by the method of Hagedorn and Jensen (*1*). The results are shown in Table 1. It is observed that lowering of the glucose level of the blood was in no instance obtained following intracisternal injection of glucose solution. There appears to be a definite tendency toward an increase in glucose content of the blood during the second hour of the tests.

The experiment was repeated using 3 dogs anesthetized 15 minutes beforehand by the intravenous administration of pentobarbital sodium in a dosage of 30 mg./kg. of body weight. The results were essentially the same as with unanesthetized animals.

TABLE 1

BLOOD-SUGAR LEVELS FOLLOWING INTRACISTERNAL INJECTIONS OF GLUCOSE IN DOGS

(Blood sugar in mg /100 ml.)

Dog No.	Preinjection	Postinjection time in minutes				
		5	15	30	60	120
1	85	87	101	102	78	97
2	118	119	132	123	125	140
3	100	108	109	126	117	128
4	96	97	95	99	102	121
5	67	77	75	84	79	108
6	76	80	81	79	87	121

We are therefore unable to corroborate the findings of Marinelli and Giunti that the injection of small amounts of glucose into the cisterna magna results in a hypoglycemic reaction in dogs. Though the weight of glucose injected in our experiments was the same as that employed by Marinelli and Giunti, we may not have duplicated their procedure exactly, inasmuch as they make no statement as to the volume of solution in which the glucose was dissolved. The volume we used was chosen with a view to maintaining isotonicity.

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The Function of Ac-Globulin in Blood Clotting[1]

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It has been shown that a newly recognized plasma factor (*1, 2, 3, 5, 6*) accelerates the activation of purified prothrombin by thromboplastin. We refer to this factor as Ac-globulin (*6*). Because of its apparent importance we have concentrated our studies on its purification and its reactions.

Ac-globulin activity of plasma is quite different from that of serum. In serum the activity is comparatively more intense. Fig. 1 illustrates the difference. Curve A shows the activation rate with Ac-globulin of serum origin, and curve B, with Ac-globulin of plasma origin. In the former reaction the production of thrombin is far more rapid, but the final yield is the same as with Ac-globulin of plasma origin. For purposes of nomen-

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[1] Aided by a grant from the U. S. Public Health Service.

clature we refer to these substances as plasma Ac-globulin and serum Ac-globulin. The properties of the two are so similar that no difference has been detected, even though both have been obtained in concentrated form.

Thrombin is the substance which is responsible for the production of serum Ac-globulin, and calcium ion is not required for that purpose. The most active thrombin preparations obtained to date have been added to large quantities of oxalated bovine plasma, and subsequently, concentrates of serum Ac-globulin have been obtained in quantity and quality equal to those obtained from bovine serum itself.

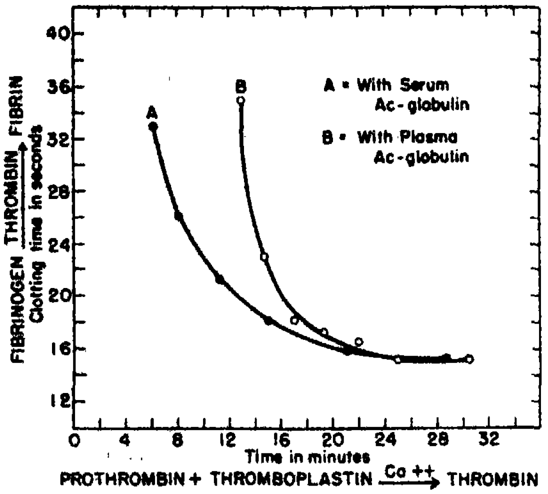

FIG. 1. Activation of purified prothrombin with serum Ac-globulin (curve A) and with plasma Ac-globulin (curve B) in the presence of excess thromboplastin and optimum calcium-ion concentration.

The function of Ac-globulin in the clotting mechanism can then be outlined by use of the following equations:

(1) Prothrombin + Thromboplastin $\xrightarrow{Ca^{++}}$ Thrombin

(2) Plasma Ac-globulin $\xrightarrow{\text{Thrombin}}$ Serum Ac-globulin

(3) Prothrombin + Thromboplastin $\xrightarrow[\text{Serum Ac-globulin}]{Ca^{++}}$ Thrombin

(4) Fibrinogen $\xrightarrow{\text{Thrombin}}$ Fibrin Clot

The clotting reaction is initiated by thromboplastin which comes from platelets and tissue juices. Some of the newly formed thrombin alters plasma Ac-globulin so that it becomes serum Ac-globulin. The latter intensifies the interaction of prothrombin and thromboplastin. Thrombin thus accelerates its own formation through an intermediate. This may be regarded as co-autocatalysis. These conclusions differ distinctly from those of Owren (*3*), but are in harmony with the old and well-known evidence presented in the literature to show that autocatalysis is involved in thrombin formation. This is, however, not autocatalysis but co-autocatalysis, because an intermediate is involved.

We have found that neither serum Ac-globulin nor plasma Ac-globulin can substitute for thromboplastin in the activation of prothrombin in the presence of optimum amounts of calcium ion.

The curves of Fig. 1 were obtained with the use of prothrombin prepared by $(NH_4)_2SO_4$ fractionation as described previously (*4*). This product possessed a maximum specific activity of 23,000 units/mg. of tyrosine. The activity was measured by the two-stage method (*7*). Plasma Ac-globulin was purified by the method briefly outlined (*5*). The same procedure was used for the preparation of serum Ac-globulin.

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The Action of Pteroylglutamic Conjugates on Man[1]

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In 1944, Leuchtenberger, Lewisohn, Laszlo, and Leuchtenberger (*4*) reported that a "folic acid concentrate" and a fermentation *L. casei* factor inhibited the growth of sarcoma 180 transplanted in female Rockland mice. Further studies by Lewisohn and his co-workers (*5*) in 1945 showed complete regression in about one-third of the single spontaneous breast cancers observed in three different strains of mice treated with daily intravenous injections of 5 μg. of fermentation *L. casei* factor. This substance was thought at that time to be folic acid; it is now known that it was a conjugate of folic acid, pteroyltriglutamic acid (*3*). Subsequent work showed that pteroylglutamic acid (folic acid), when tested under similar conditions, was not effective in producing regression of these breast cancers (*6*).

In 1944, Hutchings, *et al.* (*3*) reported the isolation of the fermentation *L. casei* factor. This compound was shown to be 60–80 per cent as active when assayed with *L. casei* and 2–6 per cent as active when assayed with *Str. faecalis* R as was the previously isolated liver *L. casei* factor, pteroylglutamic acid (*8*).

Degradative reactions have shown that the fermentation *L. casei* factor differs from pteroylglutamic acid in that the

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[1] We are grateful for the cooperation of Y. SubbaRow and his colleagues in the research division of the Lederle Laboratories Division, American Cyanamid Company, who are responsible for the chemical research which forms the foundation of these studies, and to Benjamin Carey, who made available these substances for experimental trial. The compounds were furnished in the form of dry material, yellow-orange in color, in sterile vials, under the names *teropterin* and *diopterin*.

Thanks are due to the staffs of The Children's Hospital, the Peter Bent Brigham Hospital, and to Shields Warren and the staff of the New England Deaconess Hospital, Boston, for invaluable assistance and cooperation which will be acknowledged specifically in detailed reports to be published. The assistance of Elisabeth Blumenthal, R.N., is gratefully acknowledged.

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former compound contains two additional moles of glutamic acid (*1*). Consequently, pteroyl-γ-glutamyl-γ-glutamylglutamic acid (pteroyltriglutamic acid or *teropterin*) was synthesized and found to have microbiological activities identical with those of the naturally occurring fermentation *L. casei* factor (*2*). During the course of this synthetic work the compound pteroyl-α-glutamylglutamic acid (pteroyldiglutamic acid or *diopterin*) was also prepared and found to be only slightly active when assayed with *L. casei* and *Str. faecalis* R (*7*). This compound is not a naturally occurring substance. Its preparation indicated the possibility of further research with other members of the pteroylglutamic series.

The synthesis of these two compounds by SubbaRow and his co-workers made possible experimental clinical studies with new substances of the glutamic series of known chemical structure. Our decision to employ these compounds on patients with malignant disease was based on a critical analysis of the data in the cited reports of the animal experimental work by Lewisohn and his co-workers on the effect of the fermentation *L. casei* factor (now known to be pteroyltriglutamic acid).

It is the purpose of this note to report briefly some observations made in conjunction with the administration of these and closely related substances to 90 patients with malignant disease. Only those patients for whom established therapeutic procedures offered no hope of cure were selected for treatment with these compounds. This necessary restriction to patients with advanced neoplastic disease, most of them with metastases and many of them treated previously with X-radiation, makes difficult the interpretation of data and necessitates large numbers of observations. It is too soon to attempt any evaluation of the action of these substances on the course of neoplastic disease in man. This note will therefore be limited chiefly to a consideration of toxicity, dosage, method of administration, and certain general effects. Detailed clinical and pathological studies will be reported later.

This series includes patients with acute leukemia; astrocytoma; Ewing's tumor; carcinoma of the rectum, colon, stomach, cervix, prostate, pancreas, esophagus, bladder, breast, gall bladder, kidney, and ovary; Hodgkin's disease; lymphosarcoma; osteogenic sarcoma; ependymoma; spongioblastoma multiforme; seminoma; hypernephroma; leiomyosarcoma of the stomach; chondrosarcoma; epidermoid carcinoma of the pharynx and of the tongue; and embryoma of the kidney.

The patients varied considerably in age, 8 being under 3 years of age; 29 from 4 to 10; 4 from 11 to 20; 8 from 21 to 30; 10 from 31 to 50; 28 from 51 to 70; and 3 over 71.

The duration of treatment varied from a few days to 5 months; the average length of treatment was about 5 weeks.

After cautious initial trials were made, pteroyltriglutamic acid (*teropterin*) was administered in daily doses varying from 10 to 150 mg. intramuscularly and in other patients from 20 to 500 mg. intravenously. Pteroyldiglutamic acid (*diopterin*) was given in amounts from 50 to 250 mg. intramuscularly and from 20 to 300 mg./day orally. One patient received 19,000 mg. of pteroyltriglutamic acid over a period of 5 months, and 12,740 mg. were given intravenously to another in the space of 6 weeks, in both instances without evidence of toxicity.

On the basis of experience alone our present *initial* treatment calls for the administration of 20 mg. daily of either substance intramuscularly for one week, after which the dose is raised to 50 mg./day for two to three weeks longer. Decision concerning further experimental study is then made after the status has been evaluated.

Each substance was dissolved easily in from 1 to 8 cc. of saline for intramuscular or intravenous administration. When large amounts of the material were used intravenously, as large a volume as 20 cc. of normal saline was employed.

There have been no reactions following *intravenous* administration of either substance. No important local reactions following *intramuscular* injection of pteroyltriglutamic acid have been observed. Intramuscular injection of the diglutamic compound has been followed in some, but not in all, patients by moderate local reactions described as local burning and slight aching, lasting generally not more than several hours. This reaction was said to be usually no worse than that following intramuscular injection of penicillin. In no instance was there a local reaction which required special treatment.

Systemic reactions have not been observed. No important changes in pulse, respiration, or temperature were noted, nor have there been any significant long-term variations in blood pressure. There have been no allergic reactions of either major or minor degree. Detailed clinical laboratory studies were made; analysis of these data revealed no evidence of a deleterious action of the substances administered.

Twenty-seven of the patients with advanced neoplastic disease have died, and, of these, 13 were examined post mortem. Exclusive of 11 patients with acute leukemia from whom biopsies of bone marrow were obtained, there were 11 patients from whom biopsies of the tumor were obtained both before treatment was instituted and after treatment had been carried out for a period of at least a few weeks. Study of the gross and histological material available from these patients revealed no change in organs and tissues which could be regarded as a deleterious effect of the substances employed. In no instance was there any evidence of pancytopenia, agranulocytosis, degeneration of the kidneys, liver, or myocardium, or any suggestion of a polyarteritis.

The limited number and the short duration of these observations, and the possible role of psychotherapy, necessitate postponement of any conclusion concerning general effects upon the patient. In general, adult patients experienced improvement in energy, appetite, sense of well-being, and appeared to demonstrate less irritability and apprehension. In many instances, but not in all, such improvement might be ascribed to improved morale resulting from frequent visits, more medical attention to details of their complaints, and a definite impression that something more than usual was being done for them. In a few instances there was a definite diminution in pain which could be measured by a reduction in the amount of sedation or analgesia required.

Analysis of the collected data on the group as a whole showed that in a few instances conditions were such that a causal relationship was apparent between the administration of the glutamic compound employed and changes in the patient's condition or in the histological appearance of the tumor obtained at biopsy or at autopsy. In a larger group of patients with a clinical picture complicated by the use of more than one therapeutic agent (such as radiation therapy) in addition to the glutamic compound employed, changes were observed under conditions which suggested that it was the addition of the glutamic compound which played an important part in their appearance. Examples of these changes were: temporary (several weeks) decrease in the size of multiple subcutaneous nodules of an amelanotic carcinoma; temporary (several weeks) decrease in size of metastases to the lung from a carcinoma of the testis; degeneration and necrosis which on two occasions was massive, as seen on pathological examination of tumors; reduction to normal on two occasions of several weeks each in the acid phosphatase level in the blood of a patient with multiple metastases to bone from a carcinoma of the prostate. Such changes have been by no means constant. They have occurred frequently enough, however, to warrant further experimental studies of the action of these and of related compounds on patients with cancer.

This preliminary report of the action of pteroyltriglutamic acid and pteroyldiglutamic acid on man reveals that these substances, as employed in these studies, are nontoxic and may be given either intravenously or intramuscularly. The absence of evidence of toxicity, as shown by clinical, laboratory, and post-mortem studies, and the ease of administration indicate that these substances are suitable for clinical use. No evidence has been presented in this report to suggest that these substances should be employed in the routine therapy of patients with cancer. Enough has been learned from these studies, however, to indicate that further investigation of the action of these and related compounds would be of interest.

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IN THE LABORATORY

A Mincing Apparatus for the Preparation of Embryo Extract for Tissue Culture[1]

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In order to obtain more uniformity in the preparation of embryo extract, a number of substitutes have been suggested for the tedious method of cutting with scissors until pieces of tissue are too small to be identified. One of the simplest of these is the method suggested by Earle (*1*) in which a piece of monel metal screen of known mesh size is inserted in the base of a syringe, enough pressure then being exerted on the plunger to force the embryonic material through the mesh. This works satisfactorily with young embryos. If, however, one is using chick embryos of 10 or more days of incubation, two problems arise: (1) it is very difficult to exert enough hand pressure on the plunger to force the material through the screen; and (2) the increase in pressure is accompanied by danger of breakage of the syringe.

To circumvent these difficulties the equipment illustrated in Fig. 1 was devised and made of monel metal with the help of Russell Douglas, of the Physics Department. The tubular cup (A) is large enough to contain at least two 10-day chick embryos. At one end the cup is closed by a disc perforated by holes about 1 mm. in diameter. At the other end the inside of the cup is threaded to match the threads on the plunger (B). The latter is equipped with a horizontal handle by means of which the plunger can be screwed in far enough to force all the material in the tubular container through the holes in the base. For convenience, and also to avoid handling the equipment when sterile, a holder (C) was made which fitted around the cup and could be tightened by means of a screw in contact with a flattened area on the outside of the tubular container (A).

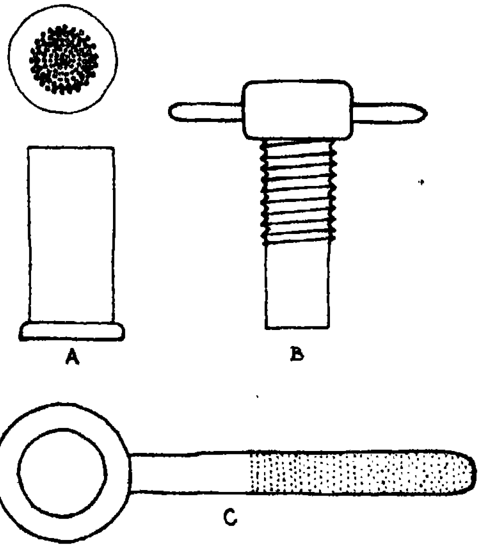

Fig. 1

This piece of equipment has proved very useful in our laboratory during the last few years. There is no danger of breakage, and the handle on the plunger and the screw arrangement make it possible to exert considerable pressure with a minimum of effort.

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[1] Contribution from the Department of Zoology, No. 216.

Use of an Electric Drill-operated Trephine in Preparing Turtles for Heart Beat Studies

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The turtle heart is excellent for many studies of the heart and its beat, both for teaching and research, because it has a strong beat, is relatively insensitive to manipulations, will beat for hours under average laboratory conditions, and requires only amphibian Ringer's solution as perfusate or as a washing solution.

The heart can be exposed only with some difficulty, since the tough shell must be cut or a portion removed. Formerly we cut the plastron from the carapace with a hack saw; this usually caused considerable hemorrhage, with resulting deterioration of the specimen.

We now use a trephine powered by a small electric hand drill. Our trephine cuts a hole 1⅞ inch in diameter, but any trephine cutting a hole 1½–2 inches in diameter will serve excellently. The handle of the trephine is removed, and the shaft is turned or ground down to a diameter of ¼ inch to fit into the chuck of the drill. The center spike of the trephine is adjusted so that it protrudes ⅛ inch.

In use, the turtle is pithed and then held, back down, on a solid table. The spike of the trephine is placed a trifle cephalad to the center of the plastron. The drill is started, and run until the disc is cut from the plastron (Fig. 1). In a good preparation, the underlying muscles are not damaged in the slightest. The disc may then be pulled from the muscles, leaving a hemorrhage-free area overlying the heart which can be seen through the tissues, beating serenely. The dissection is completed by cutting through the muscles, avoiding large blood vessels. The heart may be used *in situ* or excised for perfusion experiments.

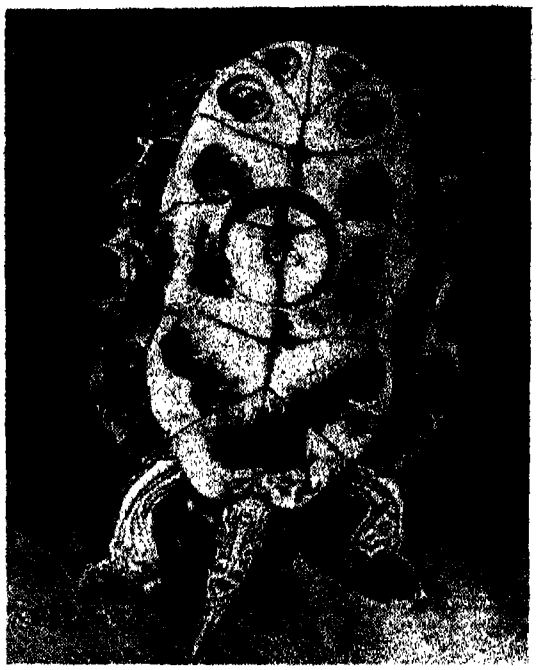

FIG. 1

This simple technic of cutting through the plastron with a trephine speeds the preparation of turtles for routine class use and prevents hemorrhage, insuring an excellent preparation.

Book Reviews

Sexual behavior in the human male. Alfred C. Kinsey, Wardell B. Pomeroy, and Clyde E. Martin. Philadelphia-London: W. B. Saunders, 1948. Pp. xv + 787. (Illustrated.) $6.50.

It is indeed a peculiarity in our human society to consider appropriate and in good taste the investigation of any structure, function, or behavior characterizing man, as a means of understanding our species, with the exception of well-directed studies on problems in sex and reproduction. However, the great advances in this field within the last 30 years have done much to provide a good foundation for further sound advances, and constructive fundamental researches on the multiple problems of sexuality are much needed.

The endorsement and support of this large research project, of which this volume is a partial report, by the Committee on Research in Problems of Sex of the National Research Council during the past 6 years; the excellent support rendered by the University of Indiana both in personnel and working facilities; the financial support and encouragement of the Rockefeller Foundation; and the preface by Dr. Alan Gregg, director of the Division of Medical Sciences of the Rockefeller Foundation, collectively assure the propriety, the merit, and the scientific soundness of the investigation. Whereas the facts revealed will shock many sensitive individuals who, like the majority, believe they know the pertinent facts of human sexual behavior because of their acquaintance with their own pattern which they consider 'normal,' the present volume will unfold an unbelievable variation among the members of the human population that must, of necessity, be comprehended before any degree of intelligence can be exercised by such counseling agencies as physicians, social workers, prison executives, institutional counseling personnel, or military authorities.

Representing some of the results from a study begun approximately 9 years ago by Prof. A. C. Kinsey, who is schooled in sampling techniques from his earlier investigations on variation among insect populations, this volume is the first in a series of 9 projected volumes in the investigation, which is scheduled for measurable completion within a period of 20 years. Dr. Kinsey has had the able cooperation of the two specially trained co-authors, who have developed the requisite technique and skill required to obtain the basic data, and also of an excellent staff of assistants; the statistical computations employed in the presentation of the materials have been enormous.

The research "is a fact-finding survey in which an attempt is being made to discover what people do sexually and what factors account for differences in sexual behavior among individuals, and among various segments of the population." It was approached in a commendable and necessary attitude of absolute unconcern with, or lack of any preconception of, what is rare or common, what is normal or abnormal, or what is morally or socially significant. The aim has been to accumulate facts and to attempt to understand the principal factors involved in a motivation of the different behaviors. The accumulated data are magnificently documented in 173 graphic illustrations and 151 tables, followed by a final chapter containing 48 pages of clinical tables with explanations for their use, and an appendix of 27 pages of tables and computations on sample size; a bibliography of more than 600 titles is included. To suggest but a very small number of the topics among those discussed, one finds data relating to early sexual growth, total sexual outlet, premarital, marital and extramarital intercourse, masturbation, nocturnal emissions, homosexuality, and the relations of age, social level, religious backgrounds, and other factors to the various facets of the general problem.

The procedures involved in the investigation are carried out by direct questions in a personal interview during which the sexual history is recorded in an essentially unbreakable code form; no written questionnaire has been employed. The strictest confidence has been maintained invariably, and the successful rapport established between interviewer and subject is nothing short of phenomenal, eliciting information which would in many instances be measurably condemnatory of the individual. The 12,000 histories already in hand come from every state in the Union, from individuals representing an age range of 5–90 years, and from all social levels—inmates of penal institutions, the underworld in general, laborers, clerks, farmers, business executives, grade schools, high schools, colleges and universities, and such professional levels as lawyers, physicians, clergymen, college professors, psychiatrists, and others. Adequate samples of histories from all social levels and geographical areas are included and will be further sought among the 100,000 histories estimated to be required to complete a final adequate assay of the total population. The present volume is based upon approximately 5,300 histories of white males. Succeeding volumes will include behavior studies in the human female comparable to the present volume on the male, sex factors in marital adjustment, legal aspects of the sexual problem, heterosexual-homosexual balance, and others.

A review of a book frequently carries criticisms of its shortcomings perhaps relative to an ideal. However, one is so thoroughly impressed with the courage demonstrated in the pursuit of this most difficult problem, with the extensiveness of the materials, with the adequate statistical treatments, with the openmindedness with which the entire project has been carried on, with the consummate artistry required to gain the basic information, and with the tenacity exhibited in the collection and presentation of the facts revealing such an unappreciated variation in human behavior, that criticism seems out of place. Some shortcomings and unfilled gaps do exist, but the authors themselves have pointed out many of them. The entire 800 pages are replete with data; what use will be made of these data remains for the acumen of the populace to demonstrate. The facts are now available, and in so effectively presenting them the authors are due the gratitude of all intelligent peoples interested in the advancement of knowledge.

CARL R. MOORE

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Vector and tensor analysis. Louis Brand. New York: John Wiley; London: Chapman & Hall, 1947. Pp. xvi + 439. $5.50.

This book develops the algebra and calculus of vectors, motors, dyadics, tensors, and quaternions. There are extensive applications to geometry, including a chapter on the differential geometry of surfaces, to analytical mechanics, and to hydrodynamics. A tensorial treatment of electrodynamics, rotating electric machines, and relativity is reserved for a projected second volume. The range of subjects is so extensive that it is easier to point out a surprising omission, such as the representation of an arbitrary vector field in terms of its divergence and curl, than to detail the contents. The book emphasizes the main ideas rather than details of rigor; the treatment is clear, concise, and formal. A principle merit is the careful interrelation of the five disciplines presented. For example, covariant and contravariant components of vectors are introduced in the first chapter on vectors; base vectors are used throughout the chapter on tensors, and a tensor is defined as an invariant under arbitrary change of base vectors; homogeneous coordinates are introduced in the chapter on vector analysis and employed also in the development of motors; the development of vector analysis from quaternions and the alternate interpretation of three-term quaternions as real plane vectors or complex numbers is explained.

There are numerous excellent illustrations and applications set as problems. The reviewer feels that this book satisfies the needs of a serious student of mathematical physics in the five disciplines included and differential geometry as well.

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Differential and integral calculus: functions of one variable. Francis D. Murnaghan. Brooklyn, N. Y.: Remsen Press, 1947. Pp. x + 502. (Illustrated.)

This represents an attempt on the part of a front-rank mathematician to present the calculus as the mathematician always dreams it might be taught. The book fully justifies the author's statement that "the method used is radically different from that of the currently popular texts." The ϵ, δ process, nested sequences, the finite covering theorem, all the machinery which one usually associates with courses in advanced calculus, mathematical analysis, functions of a real variable are used throughout to build a genuine theory of the calculus. That the result is pretty formidable is fully realized by the author, who frequently admonishes the student to read hastily over the theory and start working the exercises. Of these there are over 1,200, many with hints for the student, for the author says experience has taught him that calculus can be learned only by a judicious mixture of theory and practice. This does not mean that the theory is to be neglected or subordinated, for the student "must return as occasion permits and study over and over and thoroughly digest" the theoretical foundation on which the work stands. To do otherwise would be to miss the entire spirit of the book.

The book does excellently so many things the reviewer has long wanted to see done that he would like to recommend it unreservedly. If he cannot do so, it is because the author has aimed too high. The book will delight the mathematician; it will dismay the teacher of the calculus. For a second course it would be excellent, but for the beginner for whom it is intended it is too heavy a dose. There are rare occasions when the mathematician, against his will, is forced to yield to the professor of pedagogy; this, the reviewer feels, is one of them.

Francis E. Johnston

The George Washington University

Proceedings of the Society for Experimental Stress Analysis. (Vol. IV, No. 2.) C. Lipson and W. M. Murray. (Eds.) Cambridge, Mass.: Addison-Wesley Press, 1947. Pp. xxv + 121. (Illustrated.) $6.00.

This eighth volume of the series is a collection of 12 papers presented before the Society on subjects in the fields of static and dynamic testing of models and full-scale components, with emphasis on the electrical gaging methods and developments in the attendant circuit and telemetering techniques. All of the authors have been exceptionally careful in describing equipment and methods clearly.

Full-scale dynamic or fatigue testing is treated in six of the papers, "Fatigue Tests of Major Aircraft Structural Components," W. G. Pierpont; "A Method of Detecting Incipient Fatigue Failure," H. W. Foster; "A Machine for Fatigue Testing Full-Size Parts," A. F. Underwood and C. B. Griffin; "Some Repeated Load Investigations on Aircraft Components," S. A. Gordon; "Stress Analysis Utilization in Dynamic Testing," R. W. Brown; and "Device for Maintaining Continuous Electrical Connections With Reciprocating Engine Parts," W. A. Wallace and W. A. Casler. All of the above authors mention the inadequacy of static testing and of small model testing when the prototype is subjected to dynamic loads, and emphasize the desirability of full-scale dynamic tests.

Two of the papers, "Reluctance Gages for Telemetering Strain Data," by W. H. Pickering, and "Aircraft Instruments for Radio-Telemetering and Television-Telemetering," by C. L. Frederick, deal with problems and methods arising from the need for transmitting test data over some distance.

The remaining four papers are best described by their titles: "Precision Determination of Stress-Strain Curves in the Plastic Range," J. R. Low, Jr., and F. Garofalo; "Evaluation of Various Methods of Rotor-Blade Analysis by Means of a Structural Model," R. Mayne; "The Linear Variable Differential Transformer," H. Schaevitz; and "Design and Application of accelerometers," D. E. Weiss.

All 12 articles are worth careful study by workers in the field. The volume as a whole maintains the high quality record of the Experimental Stress Analysis series, with excellent editing and reproduction of illustrations.

D. K. Wright, Jr.

Case Institute of Technology

Scientific Book Register

Ballenger, William Lincoln, and Ballenger, Howard Charles. *Diseases of the nose, throat and ear.* (9th ed.) Philadelphia: Lea & Febiger, 1947. Pp. 993. (Illustrated.) $12.50.

Bentley, John Edward. *General psychology: principles and practice.* Philadelphia–London–Montreal: J. B. Lippincott, 1947. Pp. xvi + 389. (Illustrated.) $3.50.

Davis, Hallowell. (Ed.) *Hearing and deafness: a guide for laymen.* New York–Toronto: Murray Hill, 1947. Pp. xv + 496. (Illustrated.) $5.00.

Goldberger, Emanuel. *Unipolar lead electrocardiography.* Philadelphia: Lea & Febiger, 1947. Pp. 182. (Illustrated.) $4.00.

Haldane, J. B. S. *What is life?* New York: Boni and Gaer, 1947. Pp x + 241. $3.00.

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The Chemical Components of Onion Vapors Responsible for Wound-healing Qualities

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THERE IS PROBABLY NO OTHER FOOD TO which is attached so much legendary history as is the case with the onion, although Pliny, the Naturalist, credits it with being the remedy for only 28 maladies—a moderate figure compared with the 87 for cabbage. Many of the legends have a bearing on physical health. Considering those dealing with evil spirits, the onion is involved even in mental health.

It requires but little observation to be aware of some strikingly peculiar chemical components in the onion. Their effect on the organs of the senses of smell and sight soon make this apparent. While man has been crying over onions since the beginning of history, like Mark Twain's weather, nothing has been done about it. It is surprising that the chemistry of onion vapors with such striking characteristics has been developed to such a slight degree.

In recent years facts have appeared indicating that certain onion constituents have notable physiological properties. That onion vapors possess bactericidal properties has been shown by Walker, Lindegren, and Bachmann (*6*). In a later publication, Ingersoll, Vollrath, Scott, and Lindegren (*2*) "provisionally identified acrolein or crotonaldehyde as the bactericides" in the vapors of both onion and garlic. From the data herewith presented it will be evident that this conclusion with respect to onions is incorrect.

In Russia, B. Tokin (*4*), over a period of 14 years, studied the bactericidal, phytoncidal, and protistocidal properties of over 150 plants. Onions and garlic were found to be most potent, with horse-radish, peppers, and radishes next in order. Onion and garlic were lethal to white staphylococci, typhus, and a number of other bacteria, and to all protozoa, the latter being killed by exposure to onion vapor for 1–3 minutes. Tokin found that the onion vapors killed protozoa even more promptly than bacteria and termed the vapors "phytoncides." He also found that by chewing raw onion 3–8 minutes, and sometimes for only 1 minute, the buccal lining usually became completely sterile. Tokin judged the onion phytoncides to be extremely volatile because onion paste ceased to give off bactericidal vapors after 10–15 minutes. As will be evident below, instability rather than volatility is the true explanation.

Recently, Lucas and Hamner (*3*) demonstrated that the sodium salt of 2,4-dichlorophenoxyacetic acid became a much more potent herbicide when dissolved in onion juice diluted with 20–30 times as much water as when it was dissolved in water alone.

Inspired by such properties and impressed with the idea that ancient and traditional remedies should not be regarded as naive and absurd, Toroptsev and Filatova (*5*), of the Tomsk State University and the All-Union Institute of Experimental Medicine of the USSR, studied the effect of onion vapors on purulent inflammatory wounds. They placed the paste of one or two onions in a shallow dish the size of the wound and exposed the wound to the vapors for 10 minutes, usually in two 5-minute intervals, using the paste of fresh onion for each exposure. These investigations started with 25 patients, but for lack of onion (a striking commentary on war times) the number had to be reduced to 11. Of these, seven had amputations of the arm, one of the thigh, and three of the foot. In two of the patients the wounds were complicated with gangrene and in one with frostbite; the others were purulent and contained streptococci, white staphylococci, and other bacteria. All wounds showed distinct purulent inflammation, some with odor and edema of the soft tissue. Some patients complained of pain.

After the initial treatment all wounds became rose colored instead of gray, and there was no more complaint of pain. After the second treatment purulence subsided, odor disappeared, and regeneration was induced. Regeneration began to lag in a few cases after several days treatment, suggesting possible overexposure. Without minimizing the value of synthetic preparations to the practice of medicine and surgery, the Russian investigators take the position that the so-called phytoncides also have their place. The following study suggests to a chemist, however, that not the onion but the synthetic laboratory should be their source.

Onions were ground expeditiously in 800-gram quantities through a household meat and vegetable grinder and introduced into a 2-liter, round-bottomed flask with short neck. This was fitted with a Kjeldahl connecting bulb, which in turn was attached by a short, heavy rubber tubing to a flask imbedded in a salt-water-ice mixture to serve as a condensing receptacle. The bore of the tubing must be large in order not to impede distillation. After the whole system was pumped devoid of air by a

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"high-vac" pump, the flask containing the onion was alternately submerged in water at 50° C. and lifted out to be vigorously shaken. This alternate shaking and periodic immersion is necessary. Unless it is properly performed, the distillate will contain the constituents to be described in far-reduced quantities. The idea is to introduce heat into the mass of onion as fast as the evaporation of the distillate takes it out and to avoid heating any part of the onion mass appreciably above room temperature, since by overheating the ingredients of the distillate sought are decomposed. It required about 6 minutes to grind the onion, introduce it into the flask, and evacuate the system, and 12 minutes more to obtain an amount of distillate equal to 15 per cent of the weight of the onions.

The distillate was water clear, nitrogen free, and contained the lachrymal principle of the onion, as a tiny drop in the eye at once demonstrated unmistakably. There was only mild lachrymating effect if the eye was held against the mouth of the flask containing the distillate. This indicates that not the volatility of the lachrymal principle but the turgidity and succulence of the onion tissue, causing invisible droplets of onion juice to be dispersed, is the cause of man's weeping over onions. Whereas spooning a grapefruit may be said to deliver a macro squirt on one's tie, cutting an onion delivers a micro squirt in one's eye. The distillate had an onion odor but contained none of the essential oil to which the flavor of the onion is due; the residue retained its full onion flavor. In a short time the water-clear distillate began to take on a milky appearance and, if held until the succeeding day, the density of the milkiness was comparable to that of skimmed milk. By that time it had, however, lost every vestige of lachrymal effect or any irritation in the eye even though the distillate was stored in a closed container to prevent any escape.

Acid hastened the development of the milkiness; alkali inhibited it. Bromine almost instantaneously clears up the milkiness and produces sulfate. But if bromine is added promptly to the distillate before any milkiness develops, practically no sulfate is formed, even with heat and long standing in the presence of bromine, and the milkiness does not develop thereafter. If, after the milkiness fully develops, the distillate is again distilled under the same vacuum and temperature, the milkiness remains as a gummy residue for which no satisfactory organic solvent has been found, although bromine water momentarily clears it up with the formation of the usual quantity of sulfate.

In a typical experiment the clear distillate of five 800-gram batches of onion was collected in a tared flask from which it could be redistilled. After holding until polymerization was complete and redistilling under vacuum at low temperature there remained a residue weighing .108 gram. Upon treatment with bromine, 0.3400 gram of barium sulfate was obtained. This indicates slightly over 43 per cent of sulfur in the residue, representing the polymerized material. The sulfur content of thiopropionaldehyde and thioallylaldehyde is, respectively, 43.2 and 44.4 per cent.

Because of the unstability of this sulfur-bearing, lachrymating substance it is difficult to estimate its total quantity in onions, since loss is going on from the moment the onions are ground and during the distillation period. To arrive at an approximation, one 800-gram batch of onions was ground and subjected to distillation at once, while in the meantime enough onions for 5 additional batches were ground in the shortest time possible. From these, at 24-minute intervals, an additional batch was subjected to distillation. By reckoning the time intervals from when the grinding in each case was half completed to when the distillation was half completed and plotting these against the barium sulfate obtained, Fig. 1 was constructed. By extrapolating this to zero time it is estimated that 800 grams of onion might yield 250 mg. of barium sulfate, which, calculated as thiopropionaldehyde, amounts to 100 mg./kilo. As indicated in the graph, prompt distillation yielded 150 mg. of barium sulfate. By using tubing with a larger bore between the flasks, 190 mg. were subsequently obtained.

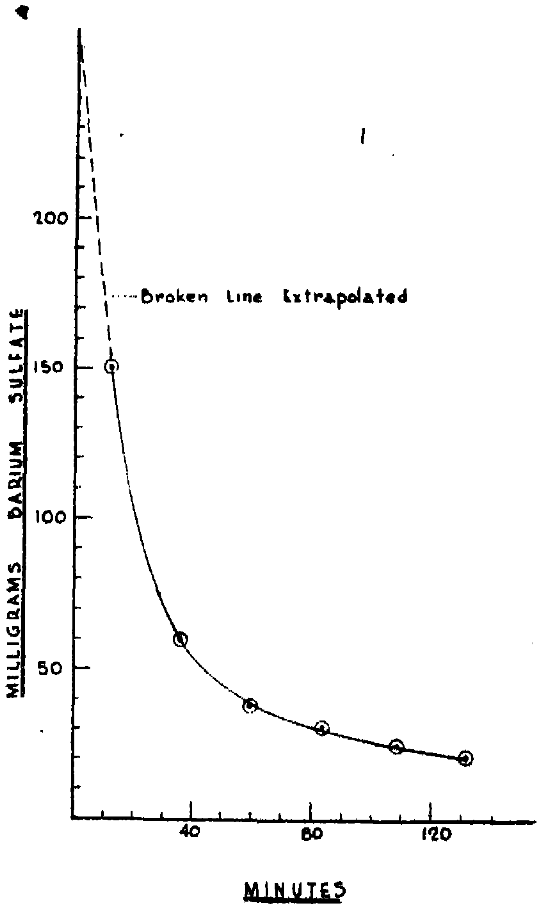

FIG. 1

These various reactions are interpreted to indicate that we are dealing with a thioaldehyde, the milkiness being the polymerized form. The fact that no sulfate is formed by bromine if added promptly after distillation and before polymerization is interpreted to indicate the reaction described by Douglass and Johnson (*1*), in which sulfonyl halide is formed from various thio-compounds. This meaningful reaction with bromine is the clue for future work toward the definite identification of this interesting thio-compound which apparently constitutes the lachrymal principle of the onion but which is not the essential oil that constitutes the onion flavor. It is suggested that it may be a step toward the synthesis by the onion of the essential oil. To our knowledge, no thioaldehyde has heretofore been demonstrated in nature. All are unstable, subject to ready polymerization.

From this low-temperature onion distillate obtained under vacuum the mononitro- and dinitro-phenyl hydrazones of propionaldehyde have been prepared and identified by melting points and analyses. The same quantity is obtained whether the preparation is made immediately after distilling, before any milkiness has developed, or after full milkiness has developed, or whether it is made from the clear distillate obtained by redistilling after full milkiness has developed, in which case the material causing the milkiness is left behind. If the phenylhydrazone preparation is made on the original clear distillate, a small amount of hydrogen sulfide is formed, which should theoretically occur if phenylhydrazine reacts with a thioaldehyde. The idea that thiopropionaldehyde is the lachrymal principle and that in the course of the development of the milkiness this is converted to propionaldehyde has not been disproved. But there seems no precedent for such a reaction. It seems more likely that the lachrymal principle is a sulfur compound present in addition to the propionaldehyde. The highly acid medium in which the nitrohydrazones are prepared would be expected to cause quick polymerization and thus prevent efficient reaction with the hydrazines.

In a typical experiment, the distillate from five 800-gram batches of onions amounted to 12 per cent of the weight of the onions and yielded 0.88 gram of dinitrophenyl hydrazone after crystallizing twice from alcohol. This is equivalent to .21 gram of propionaldehyde or 52 mg./kilo of onion.

It is thus apparent that there is a sound basis for some of the traditions bearing on health which the onion has acquired. It is conceivable that eating raw onions has a curative effect on sore throat resulting from colds. There is good reason for onion vapors having bactericidal and phytoncidal properties, and such vapors may be useful in healing wounds. But it is also apparent from the nature of the components of onion vapors that those compounds can be made available far more practically by synthetic chemical laboratories.

To control the fungus (*Urocystis cepulae*) responsible for smut in onions, formaldehyde is applied to the soil with onion seeds. The fact that this fungus no longer invades the seedling when it is several days old suggests that the seedling may protect itself by its own aldehyde. There is a tendency to ascribe any changes that take place in a broken or ruptured plant cell as being due to enzymic activity. But here we have a product removed from all contact with enzymes by distillation, yet undergoing profound chemical changes. It was recently announced that at Yale University 300 different chemical compounds have been obtained from the tuberculosis bacillus, which is a plant of but one cell. While the effect of enzymes is known to be profound, the imagination can easily picture many reactions between the numerous organic compounds that exist in organic materials such as food mixtures. The food chemist well knows that such reactions do occur spontaneously, unaided by enzymic catalysis, sometimes favorable, sometimes unfavorable. But he is still a long way from being able to control the media that contain such complex mixtures to direct the reactions according to his will.

Thus we have seen that propionaldehyde, which has been identified in the low-temperature vacuum distillate obtained from onions, is not the lachrymal principle in the onion. The lachrymal substance is concentrated in such a distillate, and the chemical reactions with it indicate a thioaldehyde. It is not so much the volatility of this substance that is responsible for the lachrymating effect of cutting an onion but the turgidity and succulence of the onion cell that disperses fine droplets of onion juice. Finally, if the components of onion vapors have a place in medicine and surgery, the organic chemist, not the onion, should supply them.

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The American Philosophical Society:

Abstracts of Papers Presented at Autumn General Meeting

The Discovery of an Oil Field

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Among the many smaller geologic basins distributed throughout the world, there are at least two gigantic basins in which great thicknesses of fine-grained marine sediments are interbedded with thick, porous, sandstone and limestone strata and are accordingly potential oil territory. One of these surrounds the present Gulf of Mexico and the Caribbean; the other borders the Persian Gulf. Although about half of the world's cumulative petroleum supply so far has been produced from the American basin, the Persian Gulf basin will undoubtedly prove to be the more productive area. The geophysical phase of a development that has led to the discovery of what appears to be the largest oil field in the world, now known as the "Burghan Anticline" in Kuwait, at the head of the Persian Gulf, is described. As a result of the pioneer work of the scientist, this general region has suddenly become one of the most important areas in the world from the standpoint of international politics and industrial development.

Benjamin Rush as a Promoter of Useful Knowledge

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Benjamin Rush's devotion to projects for improving the conditions of human life sprang from his contact with ideas and leaders of the Enlightenment during his years abroad (1766–69). A particularly profound influence was exerted upon him by Benjamin Franklin, whom he met in London. Returning to America, Rush began those studies in a wide range of scientific and quasi-scientific fields of knowledge which he continued throughout his life and which are reflected in his voluminous correspondence.

The results of his investigations are embodied, in considerable part, in papers and addresses he read to the American Philosophical Society, of which he was for some 40 years an active member and officer. A representative paper is his letter to Jefferson on the need for, and means of, encouraging the production of maple sugar. Much more important is his oration on "the influence of physical causes upon the moral faculty," a statement basic to the then unborn science of psychiatry.

Rush's repute as a medical scientist waned after his death and has not risen since. Though he served effectively as an advocate of experimental science, his own methods were uncritical, and his findings were warped by speculative preconceptions. His real contributions were in the marginal areas of medicine—to psychiatry, sanitation, veterinary science, and, above all, to medical education. His lifelong crusade for the popularization of medical knowledge, though little noted hitherto, may in the long run be considered his principal bequest to humanity. In disseminating the rules of good health, hygiene, and diet, Rush was acting in accord both with the ideals of the Philosophical Society and his own vision of a democratic America.

The Cultural Relations Attaché as an Instrument of International Understanding

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The field of cultural relations as an aspect of American foreign relations is a recent development. Under the stimulus of the war, it has emerged as an instrument of national policy. There is a grave danger that its high purpose of promoting mutual understanding between peoples will be diverted into official propaganda in behalf of American political goals.

The years of experimentation, in Latin America and other countries, have established a pattern of the types of cultural interchange which are feasible and productive. They cover a wide range of individual and institutional relationships and have demonstrated the value of reciprocal exchange as a step toward common goals.

The Cultural Relations Attaché is the key figure in the development of the program. The activities which he must carry on determine the qualifications which he must possess, for he must perform the dual function of representing to another people the intellectual ideals of the United States and of interpreting to the American people the cultural pattern of other lands. He must be supported by an adequate personnel to achieve the long-term goal of his office.

Reading and Visual Fatigue

Leonard Carmichael

Tufts College

The paper reports experiments on long periods of reading in an effort to study visual fatigue, conducted by Prof. Walter F. Dearborn, the author of this abstract, and a number of associates. A Kodachrome film shows the newly developed electrical recording technique used in the experiments. Twenty college and high school subjects read for two periods, each of which was 6 hours long. Half of these subjects read from the ordinary printed pages of a book; the other half, from a microfilm projection of book pages in a commercial microfilm projection device. Two books, one "dull" and the other "interesting," were read by each subject. Continuous recordings were made of every eye movement occurring during each of the two 6-hour periods for each subject. These records, totaling approximately 15 miles in length, were later edited and tabulated, and a number of indices, such as number of blinks, number of fixation pauses, number of regression movements, number of lines read, and the like, were studied. Careful evaluation of the results indicates that there was no statistically significant change in level of comprehension of the meaning of the material read or in any of the recorded characteristics of the eye movements during any 6-hour period. Some subjective fatigue reports were given, but these were not related to any measurable loss of efficiency in reading. The conclusion is therefore presented that, for the typical group of subjects who were studied, continuous reading for this length of time produced no measurable fatigue. Some industrial, military, and educational implications that may be derived from the study are suggested.

Environment and Culture in the Last Deglaciation

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Postglacial time differs from place to place, and the term is unsuited for dating the history of man. Critical markers of time may, however, perhaps be found in the culmination of the last glacial maximum and the ending of the subsequent deglaciation. For these, ages of 25,000 and 7,500 years, respectively, are suggested provisionally.

The pluvial climates that prevailed in low intermediate latitudes over areas now arid and semiarid, as in the American Southwest, are referred to a time anterior to deglaciation. During the latter the contemporary pattern of climates prevailed, with some exceptions in higher latitudes.

Deglaciation caused notable rise of sea level, the modern shore lines for the most part dating from the end of this period. It was also a major time of building of flood plains, of the formation of fresh and salt-water marshes, lakes, and lagoons. Optimum conditions resulted for plants and animals of shallow water, marsh, and alluvial habitats.

The Upper Paleolithic hunters gave way to the Mesolithic folk, with new basic economies. Among them were progressive groups of sedentary, riparian habits, developing skills in utilizing the resources of the waterside. The beginnings of cultivation and even of domestication fall into this period. The cradle of the new cultures is suggested as in southeastern Asia, from which the new ways of life spread also to the New World, by infiltration across high latitudes and then down the Atlantic seaboard.

Scholarship and Intelligence Problem

William L. Langer

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An important feature of the recent reorganization of the armed services is the establishment of a new Central Intelligence Agency, which in the future will direct and coordinate all the intelligence activities of the Government in so far as they pertain to the national security. This involves not only the problem of collecting essential information, but also the work of research, analysis, and presentation—in other words, a largely scholarly function. The first serious efforts at exploiting the resources of American scholarship in the fields of the social sciences were made during the recent war, and the new agency is being organized on the basis of the experience then gained. There is no longer any question that, with the country's new position in world affairs, countless foreign problems require careful study by specially trained personnel. The new experiment promises well not only to meet an urgent governmental requirement, but also to react upon the work in the social sciences themselves, with particular reference to cooperation and integration. But an immediate and urgent problem is that of finding suitable personnel, and this is a problem that should be viewed in the light of the larger program of government-supported research and training.

A Graphical Analysis of Respiratory Problems

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A description is given of a diagram in which oxygen and carbon dioxide pressures in the alveolar air of the lung are plotted as coordinates. This diagram greatly simplifies the understanding of the mathematical relation between the rate of oxygen consumption, the rate of CO_2 output, the minute volume of the ventilation, and the varying composition of the inspired air. The advantages of the diagram depend upon the fact that it can represent by straight lines the following: (1) the CO_2 and O_2 tension breathing pure O_2 at any given altitude, (2) the various CO_2/O_2 exchange ratios (R.Q.) at any given altitude, (3) the volume of the alveolar ventilation per minute for a given rate of oxygen consumption and altitude or for a given rate of CO_2 output and altitude.

Not straight lines but curves can be drawn on the same chart representing (1) the percentage saturation of the arterial blood, (2) the cardiac output at given venous pO_2 tension, (3) the venous pO_2 at a given cardiac output and other quantities.

The use of this diagram for predicting the respiratory response is illustrated by experiments depicting the movements of the alveolar point while (1) rebreathing in a closed vessel in air or O_2, (2) inhaling gas mixtures with high CO_2 in O_2 or air, (3) holding the breath in O_2 or air, (4) overventilating the lungs, (5) inhaling high O_2 or high N_2 mixtures, (6) ascending to high altitudes slowly or rapidly, (7) using pressure breathing to increase the pO_2 in the lungs and raise the altitude tolerance, and (8) breathing CO_2 mixtures at altitude.

The paper illustrates the great advance in our understanding of respiratory problems which came about during the war due to activities in many different laboratories.

A Fragment of a Greek Uncial Manuscript in Washington

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The Rare Book Department of the Library of Congress in Washington possesses an interesting single sheet of parchment which is of venerable age. It is covered with Greek text written in a beautiful, sloping, uncial hand. This parchment contains a fragment of early Christian literature, but there is no indication of either the title of the work or its author. The sheet is folded in the middle and thereby divided into two folia, both of which, recto and verso, are covered with text. These folia apparently represent the outer sheet of a quire which has at some time or other been removed from a manuscript of unusually fine quality. To what manuscript did this sheet originally belong, and is it lost or still in existence?

The present paper undertakes to identify the author and the work contained in the Washington fragment. It is possible, by comparing the handwriting on this sheet with that of other uncial manuscripts of the same type still extant, to identify the manuscript of which the fragment originally formed a part, and to delimit the time when the separation occurred. The paper then proceeds to trace the history of this manuscript, on which the Washington fragment sheds interesting new light, through the Middle Ages and early Renaissance and tries to determine the period in which it was written and the part of the world from which it originated.

Ancient Mathematics and History of Civilization

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In the history of the exact sciences the Hellenistic period will always be of special interest.

The analysis of the early development of mathematics reveals a variety of influences on this period, which extends from about the fourth century B.C. to the third century A.D. Least effective appears to have been Egyptian mathematics, because of its primitivity. The Babylonian contribution, however, was very great for the development of algebra as well as mathematical astronomy. Consequently, very different strata of "Greek" mathematics can be distinguished. Though classical "Euclidean" mathematics constitutes an enormous progress both in methods and results, its practical limits were soon reached. The survival of mathematical knowledge during the Middle Ages is to a large extent due to the continuity of the oriental tradition and to mathematical astronomy. It is especially the Persian and Arabic scientists who must be credited with the integration of the different layers of mathematical sciences into a larger unity sufficiently broad to provide the material needed for the development of mathematical astronomy, optics, and mechanics in the Renaissance.

Man's Greatest Illusion

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During almost the entire course of man's existence he has taken it for granted that he occupied a central position in the physical universe and that nonhuman objects and beings possessed attributes similar to his own. This illusion of anthropocentrism and anthropomorphism has been the greatest of all his illusions, and the most pregnant in its consequences.

We can no longer believe that we are literally at the center of the universe, as was believed by everybody down to about 10 generations ago; but it is still possible for us to believe that we are at the apex of creation, though there is no satisfactory basis for this belief, which appears to be nothing more than an instance of wishful thinking and a delusion of grandeur.

The remedy for it is the spirit of humility. Morally wise men of science and philosophy have recognized the necessity of humility for the acquisition of knowledge and the attainment of serenity; and in the realm of historiography the cure for the illusion that exalts our own age at the expense of all others is that form of humility known as historical-mindedness.

The Migration of the Methyl Group in the Body

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The paper presents the experimental background which led the author and his co-workers to the concept that the body is incapable of generating methyl groups for the methylation of certain nitrogen- and sulfur-containing compounds of the body, but is dependent on the presence in the diet of methyl groups in a utilizable form such as in methionine and choline, and that a process of transmethylation is involved in certain steps in the intermediary metabolism of the body.

Direct proof of the transfer of the methyl group was afforded by tracing the migration of the methyl group by labeling it with deuterium. More recent work on transmethylation in which the methyl group has been labeled with C^{14}, the radioactive isotope of carbon, is also presented.

Streptomycin in the Treatment of Infections

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and

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Streptomycin has been used extensively for the treatment of many infections that fail to respond to other chemotherapeutic agents. The results of its use in tuberculosis, tularemia, *H. influenzae* infections, brucellosis, and gram-negative bacillary infections are discussed. The discussion includes the over-all results in 3,000 cases.

Franklin-Greene Correspondence

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An unpublished translation, in Franklin's unmistakable hand, of a Spanish letter to Miss Catharine Ray from Don Laureano Donado del Castillo, Cadiz Bay, June 7, 1751, is one of the rare items recently acquired by the American Philosophical Society. The original Spanish is awkward and formal, but the translation is in Franklin's charmingly fluent prose. Other letters added to the Society's library include the "Be gone Business" and the famous "multiplication" letter. These letters have always been in the possession of the family.

The correspondence between Franklin and Mrs. Catharine Ray Greene is the record of their long friendship, which endured from the day they met in 1754 until his death in 1790. Yet all these years they saw each other on but five occasions. Much has been written about it, but these letters reveal a gay, tender, "cheerful and agreeable Benjamin Franklin," who has never before been so disclosed to the public.

Catherine Ray, later Mrs. William Greene, had met Franklin at her sister Judith Hubbard's in Boston while on one of her periodic escapes from Block Island, 12 miles out at sea from Point Judith, the tiny islet where she was born and raised. "Katy," as Franklin addressed her, or "Caty," as she signed herself, was the daughter of Simon Ray and his second wife Deborah Greene, a great granddaughter of Roger Williams. Other members of the extensive Greene family to appear prominently are Nathanael, the Revolutionary General, who married Caty's niece, "Kitty" Littlefield, and his brother Elihu, who married Franklin's grandniece, Jane Flagg.

On the Franklin side, after Franklin himself, the most important is Jane, his favorite sister and wife of Edward Mecom of Boston. Jane early became attached to Caty, whom she had met after John Franklin had married the widow

Hubbard in 1753. Caty and Jane were some 20 years apart in their age, and relationship was, in a way, that of parent and child, Caty calling her "my mama and friend."

The Lipit-Ishtar Law Code

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Only last March four tablet fragments in the Nippur Collection of the University Museum were identified as parts of a single tablet upon which had been inscribed a law code in the Sumerian language. This code proved to be nearly two centuries older than the celebrated Babylonian law code of Hammurabi. Heretofore, it has been generally held that the Hammurabi law code was the oldest in the world, and credit for the codification of law has been assigned to this famous king of the First Dynasty of Babylon. Now, however, we find that Hammurabi had a predecessor in a relatively little-known king of a slightly earlier period, Lipit-Ishtar, king of the city of Isin.

It is the purpose of this paper to describe the discovery, identification, and reconstruction of the Sumerian law code from the four tablet fragments with the assistance of other tablets containing excerpts of Sumerian law from the same code. A brief statement of the historic situation, based upon the revised Babylonian chronology, follows in order to place the two law codes in their proper places in time. Then the interrelationship of the Babylonian and Sumerian law codes is discussed and illustrated by passages from the respective codes. Finally, the significance of the new law code for the social history of southern Mesopotamia is pointed out.

Why Union Education?—Aims, History and Philosophy of the Educational Work of the ILGWU

Mark Starr
International Ladies' Garment Workers' Union

The International Ladies' Garment Workers' Union was chartered by the national American Federation of Labor in 1900 to organize the makers of women's garments. It now has over 400,000 members in 435 locals and is strongly established in most of the metropolitan areas of the United States and Canada. The union's educational work and its motivating philosophy show three distinct phases:

(1) Agitation for remedial action against sweatshops to give the garment workers confidence in their own union solidarity and united action. In this the ILGWU received the support of progressive politicians and social, civic, and religious groups. Since the union was largely composed of immigrant workers, the early formal classes were largely in English, citizenship, and history, orienting them to the American scene.

(2) When the union's struggle for recognition as a nationwide force in the industry had been won, there was a shift in its educational activity to establish a relation of understanding with the community and a participation in varied forms of welfare work. In the New Deal period a rapid increase in membership of American-born youth with high school background and the union's enlarged financial resources made it both necessary and possible to strengthen the relationship of the union to other sections of the community. This community activity was especially strengthened in wartime. The ILGWU continued its attempt to secure cooperation of outstanding forward-looking men and women in improving industrial conditions.

(3) Current union education has a threefold task:

(a) Union self-education for new members and the compulsory educational qualifications for its officers; and departments in research and industrial engineering to estimate trends and techniques in the garment industry to guide the policy of the union.

(b) The provision of social, recreational, and cultural opportunities directly, where necessary, but through community agencies wherever possible.

(c) The promotion of the study of industrial relations in conjunction with institutions of higher learning as a reflex of efforts in labor-management cooperation and the provision of health and welfare benefits.

The ILGWU aims by its educational work to replace social illiteracy by civic and political maturity and by the preparation and training for living in its broadest social implications.

Cepheids of the Small Magellanic Clouds

Harlow Shapley
Harvard College Observatory
and
Virginia McKibben Nail

Peculiar differences, in basic physical operations, from one galaxy to another are again suggested by current studies of Cepheid variables in the Large and Small Clouds of Magellan. Forty-nine new photographic light curves are presented, with observations based on a homogeneous magnitude system.

Anomalous characteristics appear among the hundreds of variables in these nearest of external galaxies. The Large Cloud appears to follow our own Galaxy's pattern in the distribution of period lengths. There are periods of all values from about 2 days to 100 days, with a maximum frequency near 4 days. In the Small Cloud, which is distant from the Large Cloud only about 10 kiloparsecs, and is similarly irregular in form, the maximum frequency is around 2 days—in fact, most of the periods of Cepheids in the Small Cloud fall in the interval of period lengths that is almost completely avoided by Large Cloud Cepheids.

Some additional results are now reported that again emphasize deviations from the conveniently assumed large-scale uniformity of the laws and operations of nature throughout the Metagalaxy. In the Magellanic Clouds, Cepheids of about 8-day period lengths have single maxima; in the Milky Way many of that period length have double maxima. But in the Clouds those with periods from 9 to 11 days mostly have double maxima, although in that interval the Milky Way Cepheids have single maxima. That is, there is a shift of 2 days in the appearance of this significant phenomenon.

The importance of these and similar results lies in their indication of cosmic nonuniformity, either in the distribution of the original chemical elements out of which stars are formed or in the hydrodynamical operations of a pulsing star, depending on position in space or environment.

The Freedmen and the Slaves of God

William Linn Westermann
Columbia University

In First Corinthians 7 the Apostle Paul set forth the equalitarian principle which he thought should prevail in the new Christian groups. A slave who was baptized became a "freedman of the Lord." A free man who accepted Christianity became a slave of Christ. This meant that differences in status could have no significance within the Christian communities. Each convert had been bought at the price of Christ's sacrifice; and each one was to submit himself to God as a slave, whatever the actual social status which he had at the time of his conversion. At times Paul also speaks of himself, with genuine humility, as a slave of God; and this idea has come down in the Church, in the bulls of the Popes, in which they speak of themselves under the humble title of *servus servorum Dei*.

The Greek temple organizations might have slaves; but the Greek gods did not have them. The Semitic gods, on the other hand, *did* have slaves. In the Greek city-states, particularly at Delphi, a system had arisen by which a slave might redeem himself through a trust purchase made by the god. When the god bought him, automatically the slave became free because the god had no slaves. The new freedman often contracted to serve his former owner for a time. This form of service, and the labor contract which covered it, was called a *paramone*. Paul had this legal formula of the Greek world in mind when he spoke of the freed man of the Lord. The idea, however, of the free man who became the slave of God was not Greek but came from the Semitic background of Saul of Tarsus.

Obituary

Ellsworth Huntington
1876–1947

Yale's Prof. Huntington was such an earnest, energetic searcher after truth, so desirous of making the best possible use of available information, so bold in presenting challenging hypotheses, and so skillful as a writer that his passing will be widely mourned. His early geological work was so notable that he was starred as a distinguished geologist in *American men of science*. He received medals from leading British, French, and American geographical societies for geographic exploration in little-known areas in Asia, and the "Distinguished Service to Geography Award" of the National Council of Geography Teachers. He served as president of the Association of American Geographers, the Ecological Society of America, and the American Eugenics Society, and as associate editor of the *Geographical Review*, *Economic Geography*, *Ecology*, and *Social Philosophy*. Numerous historians, economists, anthropologists, meteorologists, climatologists, physicians, and many others have frequently cited one or more of his numerous publications and acknowledged his stimulating influence in their fields. His several geographic textbooks have been widely used, serving students on all levels from grammar school to postgraduate work. An extensive investigation made a decade ago revealed that he was the most widely known American geographer—known not only by people interested in the earth sciences but by educated people generally. Several of his books have been translated into other languages.

Huntington is known especially for his researches in seven great fields and for the presentation of findings so attractively that reading is a pleasure. His prolonged studies of past climates established that there have been highly significant changes of climate and that these were pulsations, not cycles or progressive. He proved by numerous factual studies that climatic conditions have profound influence upon man and his culture, upon other forms of life, and upon geologic processes. He also proved that the changes of weather, although brief and erratic, affect man's health, attitudes, and achievements and even his energy and longevity. He assembled convincing evidence that the distribution of "civilization" over the earth corresponds with that of climate. The climate best suited for intellectual activities is one having frequent changes of weather, well-marked seasons, and enough warmth and rainfall to permit extensive agricultural production, but not too much warmth. He concluded that temperatures above 68° are unconducive to thought, while frequent drops below 50° are distinctly stimulating. His theories that changes in the sun are major causes of terrestrial climatic changes and that frequent, relatively intense, cyclonic disturbances, "storms," are conducive to intellectual progress have stimulated much discussion and ever-widening adoption. One of his several stimulating theories is that not only has civilization shifted northward into cooler climates as mankind has advanced in his culture, but for each of the chief crops and types of farm animals there has been a northward improvement (in the Northern Hemisphere) in yield and quality almost to the poleward margin of the crop's or animal's range.

Huntington, although sometimes considered to be an "extreme environmentalist" by persons who have not read his works carefully, was keenly aware that the physical environment generally is of secondary or indirect significance for mankind. The great influences of selective migration and of the intermarriage of certain types of people are stressed in his *The character of races* (1924) and elaborated upon at length in *Mainsprings of civilization* (1945). In his *Human habitat* (1927) this subject is attractively and briefly presented.

Huntington was the author or co-author of more than 25 volumes, contributed a chapter to each of about 20 other books, and wrote more than 130 articles, more than a score of which were in magazines of wide circulation. His books include *Explorations in Turkestan* (1905), *Pulse of Asia* (1907), *Palestine and its transformation* (1911), *The climatic factor as illustrated in arid America* (1915), *Civilization and climate* (1915, 1924), *World power and evolution* (1919), *The red man's continent* (1919), *Principles of human geography* (1920–1940), *Principles of economic geography* (1940), *Climatic changes: their nature and causes* (1922), *Earth and sun* (1923), *The character of races* (1924), *West of the Pacific* (1925), *Quaternary climates* (1925), *Pulse of progress* (1926), *Builders of America* (1927), *Weather and health* (1930), *Living geography* (1932), *Tomorrow's children* (1935), *After three centuries* (1935), *Season of birth* (1938), and *Geography of human affairs* (1947).

Mainsprings of civilization (1945) is a monument not only to his exceptional erudition, energy, and persistence but to American science. Indeed, *Time*, in its recent obituary, characterizes it as surpassed only by Toynbee's classic in breadth of scholarship, wide interest, and literary attractiveness.

Dr. Huntington was born in a manse in Galesburg, Illinois, went to southwestern Asia upon graduating from Beloit College in 1897, returned again to Asia for further extended exploration after two years at Harvard (1901–03), and carried on years of field research in southwestern United States and Mexico. Later he did extensive field work in Europe, Africa, Australia, and South America. No other geographer has made such prolonged and varied foreign field studies, and none has shared his observations so attractively. *West of the Pacific* is considered by some competent persons as a "gem" of descriptive geography, but most of his works include effective descriptions. His death, from a heart attack on October 17, 1947, terminated his work on *The pace of history*, a supplement to *Mainsprings of civilization*. Undoubtedly Huntington's influence will be considerable as long as our civilization continues.

STEPHEN S. VISHER

Indiana University, Bloomington

NEWS
and Notes

Bernard F. Riess, professor of psychology, Hunter College, has been appointed research associate, Department of Animal Behavior, American Museum of Natural History. Dr. Riess, who is spending a year at the Museum as a Guggenheim Fellow, is investigating biochemical factors affecting behavior in mammals.

Ernst Antevs, formerly of Harvard University and the Carnegie Institution of Washington, has been appointed research associate in glacial geology, Chicago Natural History Museum, and **Ch'eng-chao Liu**, professor of zoology, West China Union University, Chengtu, has been appointed research associate in the Division of Reptiles.

Jay McLean has resigned as associate professor of surgery, Ohio State University, to become director, Bureau of Cancer Control, Health Department, Government of the District of Columbia, Washington, D. C.

Hayse H. Black, formerly officer in charge, U. S. Section, International Joint Commission Boundary Water Pollution Investigation, Detroit, has been appointed associate professor of sanitary engineering, Department of Civil Engineering, State University of Iowa.

Laurence H. Snyder, dean of the Graduate College, University of Oklahoma, has been giving talks at various institutions on the general subject of human and medical genetics. On October 23 he spoke before the student body at Hollins College, Virginia; on October 28, before the Fort Henry Academy of Medicine, Wheeling, West Virginia; on December 5, before the Terre Haute Academy of Medicine; and on December 11, at the annual initiation ceremonies of Phi Sigma at the University of Texas.

Willard Rouse Jillson, geologist and engineer, Frankfort, Kentucky, and formerly director of the Kentucky Geological Survey, has been appointed professor and head, Department of Geology, Transylvania College, Lexington, Kentucky.

Walter Buehler, a graduate of Purdue University and past-president of the American Wood Preservers Association, has been appointed consultant in wood technology and preservation, School of Forestry, University of Florida.

Sidney Q. Janus has been appointed part-time professor, and **A. S. Glickman** as instructor, in the Department of Psychology, Georgia School of Technology.

Grants and Awards

Six new grants for research in mental health under the National Mental Health Act have been recommended by the National Advisory Mental Health Council and approved by Thomas Parran, Surgeon General, U. S. Public Health Service. Institutions receiving the grants, and their project directors, follow: University of California, Berkeley, **Karl M. Bowman**, professor of psychiatry and medical superintendent, and **Jurgen Ruesch**, research psychiatrist and lecturer in psychiatry, Langley Porter Clinic; Columbia University, College of Physicians and Surgeons, **Abner Wolf**, associate professor of neuropathology; The Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, **J. P. Scott**, chairman, Division of Behavior Studies; Mu Iota Sigma Fraternity, Illinois School for the Deaf, Jacksonville, Illinois, **M. Arline Albright**, associate professor of education and psychometrist, and president, Mu Iota Sigma Fraternity, Milwaukee, Wisconsin; Wayne University School of Public Affairs and Social Work, Detroit, Michigan, **Fritz Redl**, professor of social work, and **Ronald Lippitt**, director of research, Research Center for Group Dynamics (Massachusetts Institute of Technology); and Wesleyan University, Middletown, Connecticut, **David C. McClelland**, assistant professor, Department of Psychology.

Charles Clemon Deam, Indiana, botanist, received the second Mary Sope Pope Medal of the Cranbrook Institute of Science, December 18, in recognition of a lifetime of collecting and publishing on the Indiana flora, and especially for his work, *Flora of Indiana*.

Colleges and Universities

The Medical School of the University of Birmingham, England, will conduct a four-week Post-Graduate Summer School, July 10–August 7, 1948, which is intended for American, British, and European students, both men and women, who have done advanced study in the appropriate fields of science and medicine. The session, to be divided into two terms of two weeks each, will offer the following main courses: (A) The Physiology of the Sex Hormones, four weeks, 16 seminars; (B) Normal and Abnormal Fat Absorption in Experimental Animals and Man, first term, 8 seminars; and (C) Lipoprotein Association in Biological Systems, second term, 8 seminars. Several short courses will be arranged in each term, as well as a series of visits to leading hospitals, medical centers, and places of historical interest in the vicinity. Opening speakers at seminars will include S. Zuckerman, professor of anatomy, University of Birmingham, and A. C. Frazer, professor of pharmacology, University of Birmingham. J. J. Elkes, lecturer in pharmacology, and P. L. Krohn, lecturer in anatomy, both of the University, will be deans of the School for the first and second terms, respectively, while Sir Leonard Parsons, dean, Faculty of Medicine, and emeritus professor of pediatrics, will be president of the School. Cost of the four weeks will be $96 for tuition, and $80 for board and room in one of the University residence halls. American applications should be submitted by March 15 to the Director, Institute of International Education, 2 West 45th Street, New York 19, New York, marked "Birmingham University Medical Summer School."

Meetings

The 1948 annual meeting of the American Institute of Chemists will be held Saturday, May 8, 1948, at the Hotel Pennsylvania, New York. The program, to be announced later, will commemorate the Silver Anniversary of the Institute, which was founded in New York in 1923.

The First International Poliomyelitis Conference will be held at the Waldorf-Astoria Hotel, New York, July 12–17, 1948, under the sponsorship of the National Foundation for Infantile Paralysis. More than 60 foreign countries are expected to be represented by officials who will be asked to present summarizations of the problems of poliomyelitis in their countries at a special session which will be in charge of Thomas Parran, Surgeon General, U. S. Public Health Service. Basil O'Connor, president of the Foundation, will be the official host to the delegates, while Hart E. van Riper, medical director of the Foundation, has been appointed general chairman. Scientific and technical papers on research and treatment of poliomyelitis will be presented by professional authorities from this country and abroad, and in addition, the program will include panel discussions on the various subjects. The program is being arranged by an advisory board including Irvin Abell, clinical professor of surgery, University of Louisville; Morris Fishbein, editor, *Journal of the American Medical Association*; David Lloyd, associate member, Rockefeller Institute for Medical Research; Kenneth Maxcy, professor of epidemiology, Johns Hopkins University; Rustin McIntosh, professor of pediatrics, Columbia University; Frank Ober, professor emeritus of orthopedic surgery, Harvard University; and Thomas Rivers, director, Hospital of the Rockefeller Institute for Medical Research.

In addition to the sessions, there will be a scientific exhibit section, demonstrations of muscle testing and treatment procedures, and a film program. Coordinating this phase of the Conference will be an advisory committee consisting of Thomas G. Hull, director of scientific exhibits, American Medical Association, and Charles F. Branch, director of scientific exhibits, American College of Surgeons.

Conference headquarters have been established in the Waldorf-Astoria under the direction of Stanley E. Henwood, of Chicago, who has been appointed executive secretary.

An International Rheological Congress will be organized, on the initiative of the British Rheologist's Club, by a group of Dutch rheologists under the sponsorship of the Joint Committee on Rheology of the International Council of Scientific Unions and the Rheological Committee of the Royal Netherlands Academy of Sciences at Amsterdam. The Congress will probably meet in Scheveningen, Holland, September 21–24, 1948. The provisional program follows: Tuesday morning, general lecture on Recent Developments in the Theory of Viscosity; afternoon, communications from the Joint Committee, and general lectures on Nomenclature, and Fundamental Experimental Methods; Wednesday morning, sectional meetings; afternoon, lectures on Solutions of Macromolecular Substances, and Russian Work on Rheology; Thursday morning, sectional meetings, and lecture on Relations Between Stress and Strain in Complicated Systems; afternoon, lectures on Abnormal Substances and Abnormal Phenomena of Flow, and Psychophysical Aspects of Rheology; evening, informal dinner and entertainment; Friday morning, sectional meetings, and lecture on Rheological Problems in Biology; afternoon, lecture on Rheology in Industry, and communications from the Joint Committee; Saturday, and possibly the following Monday, excursions if sufficient interest is shown.

Those wishing to present a paper should communicate with the first secretary, Dr. R. Houwink, Rubber-Stichting, Julianalaan 134, Delft, Holland. Manuscripts must not exceed a maximum space of 3,000 words, formulas and diagrams included, and must be received before May 1, 1948. The maximum time to be allowed each paper in the sectional meetings will be about 30 minutes, and it is expected that the speaker will give only a short account of his paper so that ample time will be available for discussion. Reprints of all papers will be forwarded to participants at least a month in advance of the Congress. Registration fee will be about $5.00.

The organizing Committee, headed by J. M. Burgers, chairman, and Dr. Houwink (Rheological Committee of the Netherlands Academy of Sciences), consists of H. Kramers (Netherlands Physical Society), A. J. Staverman (Netherlands Chemical Society), R. N. J. Saal (Section of Oil Technics, Royal Institution of Engineers), A. van Rossem (Society for Materials), and H. C. den Daas, assistant secretary.

The Indiana Academy of Science held its 63rd annual meeting, October 16–18, at Ball State Teachers College, Muncie, Indiana. The annual banquet was held Friday evening, followed by an address by J. F. Mackell, president, on "Graduate Degrees for College Science Teachers." An anonymous donor has made possible the establishment of an annual award to be given in each of two sections of the Academy for outstanding work during the previous 5 years. The awards will bear the names of past-presidents. At this meeting Ray C. Friesner, head, Department of Botany, Butler University, was awarded the John M. and Stanley Coulter Prize in Botany, and J. Paul Scott, formerly of Wabash College, was granted the David Starr Jordan Prize in the Zoology Section. Approximately 100 papers were read at the 12 divisional meetings on Friday and Saturday.

At the close of the business meeting Winona Welch, DePauw University, was elected president; Mason Hufford, Indiana University, vice-president; O. B. Christy, Ball State Teachers College, secretary; Donald E. Miller, Ball State Teachers College, assistant secretary; W. P. Morgan, Indiana Central College, treasurer; P. D. Edwards, Ball State Teachers College, editor; and William A. Daily, Butler University, press secretary.

The press secretary has announced that the 1948 annual fall meeting will be held October 28–30 at Indiana University, Bloomington.

T. H. Manninen, as the newly appointed manager of development, U. S. Industrial Chemicals, Inc., will supervise all pilot plant and engineering development activities of the company. Dr. Manninen has been with USI since 1937.

Centro Research Laboratories, Briarcliff Manor, New York, have recently become associated with Chemisch-Technisch Adviesbureau, Haarlem, Holland, which is directed jointly by J. Rinse, a leading research worker on the continent in the field of organic coatings, plastics, pigments, and associated materials, and W. Dorst, a specialist in plant layout, especially design and the practical application of paints and other coating materials. The Holland plant has carried out extensive studies in the chemistry of both raw materials and intermediates such as the polymerization, dehydration, vinylation, and blowing of linseed, soybean, tung, oiticica, and castor oils, resin modification, chlorination of rubber, the formulation of fungicides and preservatives, and the products of pigments and other raw materials. The development of new and interesting products such as metal putties, plastic coatings for concrete, and grease-resisting and shrinkage-controlled textiles is anticipated by Centro as a result of this new association with the Dutch concern.

Recent Deaths

G. H. Hardy, 80, formerly Sadleirian professor of mathematics, University of Cambridge, England, died on December 1 in Cambridge. Prof. Hardy was recently named to receive the Copley Medal of the Royal Society.

S. Lawrence Bigelow, 77, professor emeritus of general and physical chemistry, University of Michigan, died December 3 in West Hartford, Connecticut.

Wesley G. France, 55, professor of colloid chemistry and electrochemistry, Ohio State University, died December 4 of a heart attack.

Rollins A. Emerson, 74, head of the Department of Plant Breeding at Cornell University from 1914–1942, and dean of the Graduate School from 1925 to 1930, died December 8 at Ithaca after a long illness.

Lord Rayleigh, 72, onetime president of the British Association for the Advancement of Science, emeritus professor of physics and chairman of the governing body, Imperial College of Science, died December 13 at his home near Witham, Essex, following a heart attack.

Earl S. Johnston, 58, chief of the Division of Radiation and Organisms, Smithsonian Institution, died December 17 at his home in College Heights, Maryland, after an illness of several months.

The American Museum of Natural History is sending the first major American expedition to the Cape York Peninsula, Australia, in March, for a 6-month zoological and botanical exploration. The 1948 Archbold Cape York Expedition will be led by **Leonard Brass,** Museum botanist, who has already left for Australia, and include as party members, **G. H. H. Tate,** curator, Department of Mammals, **Hobart M. Van Deusen,** also of the Department of Mammals, and **G. M. Tate,** who will be in charge of transportation, and collection of insects, reptiles, and amphibians. This is one of a series of biological investigations in Australian and New Guinea areas conducted by Archbold Expeditions, an organization established by Richard Archbold and affiliated with the Museum. This expedition will concentrate on the collection of mammals and plants, although amphibians, reptiles, and insects will also be sought for the Museum's collections. The group expects to discover a number of new species of both mammals and plants. Seeds of palms and other ornamental plants will also be collected for cultivation at the Fairchild Tropical Garden in Florida. It is believed that the most interesting and profitable areas for collecting will lie in the northern part of the Peninsula, between Coen and Somerset. The group will establish a series of bases connected by water transport on the eastern coast of the Peninsula, and will cover not only the tropical rain forest areas there, but work into the western open Eucalyptus forest territory, making it possible to study a wide range of biological environments of the Peninsula. The plant collections will go to the Arnold Arboretum, which is giving financial support to the project.

Electronic engineer and physicist positions are available in several Federal research laboratories, including the U. S. Navy Underwater Sound Laboratory, Fort Trumbull, New London, Connecticut; Naval Research Laboratory

Field Station, 470 Atlantic Avenue, Boston; and the Cambridge Field Station, Watson Laboratories, Air Material Command, 230 Albany Street, Cambridge, Massachusetts. Salaries range from \$3,397 to \$8,179 per year. To qualify, applicants must have completed (a) a full four-year college course with major work in physics, mathematics, or engineering science, or (b) at least four years of progressive technical experience in engineering or physics, or (c) any time-equivalent combination of education and experience. All applicants for the position of physicist must have completed 24 college semester hours in physics. In addition, all applicants must have had from one to four years of progressive professional experience in the appropriate field. Graduate study may be substituted for experience up to a maximum of two years of experience. No written test is required. Full information and application forms may be secured from most first- and second-class post offices, from civil service regional offices, or from the U. S. Civil Service Commission, Washington 25, D. C. Interested persons should ask for Announcement No. 1-34(47). Applications will be accepted until further notice by the executive secretaries of the Boards of U. S. Civil Service Examiners at the laboratories named above.

TECHNICAL PAPERS

The Common Cold: A Note Regarding Isolation of an Agent[1]

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For the past few months studies of the common cold have been in progress by the National Institute of Health. The infectiousness of nasal washings from cases of the disease and from laboratory materials has been investigated by intranasal inoculations of adult male volunteers[2] in a nearby correctional institution. Attempts to isolate and cultivate an agent or agents have been carried out at the Institute.

On January 13, 1947, nasal washings in sterile skimmed milk (*1*, *4*, *10*) were obtained from an individual within 24 hours of onset of cold symptoms. After laboratory studies to rule out, in so far as practical, the presence of dangerous pathogens, the unfiltered washings were given intranasally to 5 volunteers who had been in strict isolation in the institution hospital for 6 days. All subsequent groups had preliminary isolation periods of 6–8 days. After an incubation period of from 36 to 48 hours, all 5 volunteers developed symptoms and signs of minor upper-respiratory infection with considerable variation in severity.

All 5 complained of fatigue, nasal obstruction, and frequent expectoration. Three complained also of sneezing, headaches, coughing, and burning, watery eyes. Two experienced prodromal chilly sensations and hot flashes. Objectively, hyperemic obstructed nasal passages, red throats with prominent lymphoid follicles, and large quantities of postnasal mucus for 2–5 days were evident. Slight temperature elevations between 99° and 99.6° developed after onset. One volunteer suffered all the above complaints to a more severe extent, and in addition developed moderate rhinitis, a mild laryngitis for a day, moderate pharyngitis, episodes of sharp, sticking pains substernally for 3 days (X-rays normal), and a temperature elevation to 102° F. for a day.

Nasal washings in sterile skimmed milk taken within 24 hours of onset of symptoms in this volunteer were inoculated into embryonated hens' eggs along with 1,000 units of penicillin and 100 units of streptomycin.

After two passages by way of the allantoic cavity, there was an unusual number of deaths of embryos between the 4th and 6th days following inoculation. The fluids from these proved bacteriologically sterile, and several substrains were established. One of these substrains was tested in the 4th passage in human volunteers and produced a mild illness reminiscent of the original volunteer group. In fluids from the 5th egg passage, however, no obvious clinical disease was produced.

A second substrain was passed blindly every 3 days. After 8 passages allantoic fluids were tested in a group of volunteers with a failure to produce disease.

A third substrain was carried through 4 allantoic passages, transfers being made from the 5th to the 7th day following inoculation. Occasional embryos died between the 3rd and the 5th days. After the 4th passage a pool of allantoic fluid, when tested in volunteers, produced mild coryza and a slight elevation of body temperature. An equal number of volunteers given normal allantoic fluid remained well.[3] Two substrains were started from the allantoic fluid pool which produced the

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[1] In this brief paper no attempt is made to review the literature. Some previous reports concerning the isolation of a possible agent or agents are listed under References (*2*, *3*, *5–9*).

[2] Certain criteria have been established for the selection of volunteer participation in the study. Volunteers must be healthy, physically fit, adult males between the ages of 20 and 40 years, who have given no history or physical findings of chronic sinusitis, allergic rhinitis, tuberculosis, or recent pneumonia. They must have no history of any respiratory infection for the past 6 weeks and no nasopharyngeal abnormalities.

We wish to acknowledge the generous cooperation of the volunteers as well as that of the Department of Corrections, District of Columbia, in making its facilities available for the human studies of the common cold.

[3] *Volunteers, hospital attendants, and the nurse are purposefully kept* unaware of the nature of the inoculum and the identity of the controls. The volunteers frequently are apprehensive for the first 24–48 hours following intranasal inoculation. In most control groups some mild and transient nasal irritative phenomena are observed during this period. Between 25 and 50 per cent of the controls have occasional sneezing and slight nasal obstruction with some hyperemia and swelling of the nasal mucosa. A few have complained of a headache. In several controls a brief temperature rise has occurred.

mild illness. Both of these were tested in groups of 7 human volunteers. All 7 in each group developed signs and symptoms comparable to the upper-respiratory infections seen in the original donor and the first volunteer group. However, in this total of 14 volunteers the illness was more severe and of longer duration, persisting 7–11 days. After 7–24 hours incubation, all complained of dry, irritated throats (without objective pharyngitis) and exhibited malaise out of proportion to physical findings. Within a few hours nasal obstruction and postnasal discharge with frequent expectoration developed and remained prominent during the course. All complained of frequent supraorbital headaches, moderate sneezing, and an infrequent, mild, nonproductive cough. Hoarseness was evident in 9, one of whom became aphonic for about 12 hours. Nine complained of burning, watering eyes (with mild conjunctivitis objectively) and vague chest aches without significant X-ray findings. Intervals of profuse serous rhinitis were observed in 5. Early in the illness, 5 complained of chilly sensations and hot flashes. Objective signs of pharyngitis, lymphoid follicular prominence, hyperemic obstructed nasal passages, and profuse postnasal discharge were observed in all. Temperatures between 99° and 100° F. occurred at irregular intervals in 12 volunteers. No significant urine or white blood count changes were apparent. An equal number of controls selected at random from among the volunteers received normal allantoic fluids with and without chorioallantoic membranes at the same time and under conditions identical with those receiving infectious material. These men remained well and showed no change in diurnal temperature variations.

Sixth-passage allantoic fluid produced a moderately severe upper-respiratory infection of 8–11 days duration in 15 of 16 volunteers inoculated intranasally.

Seventh-passage allantoic fluid produced a similar clinical disease in 14 of 16 volunteers. No decrease in severity of infection has been evident.

To date, 8 groups of volunteers totaling 60 individuals have been inoculated with allantoic fluids or fluids plus membranes from embryonated hens' eggs inoculated with the agent. Of the 60 individuals, 57 have developed a characteristic syndrome that has been consistent through the 8 groups. Simultaneously, 8 groups of controls totaling 48 individuals have been inoculated with noninfected allantoic fluids or fluids plus membranes. Except for mild, transient, nasal irritative phenomena in from 25 to 50 per cent of these, they have remained well.

The exact nature of the agent, whose presence in the allantoic fluids and in macerated allantoic membranes plus fluids was demonstrated by producing signs and symptoms in the human volunteers, has not been defined. Bacteriological cultures of allantoic fluids and of fluids plus macerated membranes have been sterile in thioglycollate and Casman's blood agar media. Preparations stained by the Giemsa and Macchiavello techniques, when studied microscopically, have failed to reveal bodies suggestive of bacteria or the larger viruses.

The material has so far failed to produce symptoms in several strains of mice, hamsters, rats, cotton rats, guinea pigs, and rabbits. Allantoic fluids have failed to agglutinate chicken red cells, and the volunteers have shown no rise in antibody to either influenza A or B.

The infectiousness of the material is preserved, at least for several weeks, when rapidly frozen at −70° C. and stored in the frozen state at −50° C. Preliminary electron microscopic observations carried out by R. W. G. Wyckoff have shown characteristic particles in some active preparations which have not thus far been seen in preparations from normal allantoic fluids or from fluids of eggs inoculated with normal fluids. These particles are of the same general size as viruses of the influenza type but are readily distinguishable from them.

The substrains have been carried through several additional serial passages. Deaths of the embryo are quite infrequent, and grossly little, if any, change is noted in the embryo or membranes. Further testing of the material in human volunteers will be done as well as more extensive laboratory investigations.

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The Effects of Vitamins on Phosphorus Metabolism in the Chick Embryo:

1. Vitamin D and the Utilization of Inorganic Phosphorus

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As a preliminary experiment in the biophysical use of radioactive and stable isotopes, we have undertaken studies to obtain quantitative data relative to the effects of vitamins on the metabolism of phosphorus compounds in the developing chick embryo. Our initial work has been with vitamin D.

The biochemical action of vitamin D has been extensively studied (*1*). The most attractive hypotheses as to its mode of action seem to be that the vitamin accelerates the conversion of organic phosphorus into inorganic (*1*, *4*) or, at least, intensifies the turnover of phosphorus in the bone (*5*). This work was performed with immature animals. Our experiments indicate that the vitamin accelerates the turnover of phosphorus in the developing embryo.

Large brown eggs (New Hampshire) were injected with 0.1 ml. of an isotonic solution of NaH_2PO_4 with an activity of 639.5 counts/second, or 0.12 microcuries. (The efficiency of our Geiger counter equipment, as determined by daily checks with the Bureau of Standards sample of Radium D and E, No. 26, was 9.84 per cent.) A portion of the eggs also received 0.1 ml. of propylene glycol containing 20 units of vitamin D;

another portion, 0.1 ml. of propylene glycol only; and the final group, only the NaH_2PO_4. The eggs were sealed with sterile paraffin, marked, and placed in a modified Buckeye incubator with temperature and humidity control. Thirteen-day embryos proved convenient for analysis with a relatively high (40 per cent) survival rate.

The viable embryos were lifted with sterile forceps, cleaned of adhering membranes, and dropped immediately into liquid air. They were ground to a powder in a chilled mortar and the powder extracted several times with cold 10 per cent trichloroacetic acid followed by extracts with cold 5 per cent acid. The scheme of separation followed, with some modifications, that of Hevesy, *et al.* (*2*). The acid extract was filtered into cold, concentrated sodium hydroxide. The resulting solution was divided into three parts. From one aliquot we determined the average acid-soluble phosphorus compounds; the second aliquot was precipitated with 25 per cent barium acetate at pH 6.5, the precipitate was washed with dilute barium acetate, centrifuged, and a part dissolved in cold nitric acid. The solution was treated with ammonium molybdate reagent. This precipitate consisted of the inorganic phosphorus. The remainder of the barium acetate precipitate was ashed and the phosphorus determined. This fraction consisted of inorganic phosphorus plus adenosine phosphorus. The third aliquot was hydrolyzed with normal hydrochloric acid and 0.1 normal ammonium molybdate for 30 minutes at 40° C. The phosphorus released from the organic compounds precipitated. This fraction consisted of inorganic phosphorus plus phosphocreatine. The residue from the acid extractions was treated with an alcohol-ether mixture. The filtrate contained the phosphatide phosphorus, and the residue gave the so-called residual phosphorus containing mainly nucleoprotein phosphorus.

TABLE 1

Fractions	Activity: $\left(\dfrac{\text{Average counts}/\mu g \text{ of phosphorus}}{\text{Counts from 0.1 ml. of original } NaH_2PO_4 \text{ solution}} \times 10^{+3}\right)$		
	Group receiving P* and vitamin D	Group receiving P* and propylene glycol	Group receiving P* only
Average acid soluble	0.530	0.522	0 633
Inorganic P	6.03	19.70	5.69
Adenosine P + inorganic P	8.12	4.00	2.18
Creatine P + inorganic P	4.15	3.64	3.32
Phosphatide P	2.33	1.65	0.825
Residual P (nucleoprotein)	3.02	2.10	0.285

$P^* = P^{32}$ in NaH_2PO_4.

The phosphorus was determined in a Coleman junior spectrophotometer at 650 mμ, according to the procedure of Kitson and Mellon (*3*).

A summary of our results is given in Table 1. Detailed analyses for each embryo and for anatomical parts of 18-day embryos will be presented at a later date.

Our data reveal that the group of 6 embryos receiving the P* and vitamin D shows a higher specific activity for all fractions except inorganic P and the average acid-soluble P than the group of 5 embryos which received P* and propylene glycol and the 2 embryos which received only P*. The inorganic phosphorus value for the second group is inordinately high, but we can discover no contamination or error. These average values support the contention that vitamin D accelerates the over-all metabolism of inorganic phosphorus in the developing chick embryo. The effect is most marked in the adenosine, creatine, and phosphatide phosphorus fractions. Our data do not show any marked influence of vitamin D on the specific activity of the inorganic phosphorus fraction.

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Streptomycin Therapy in Experimental Tuberculosis of Guinea Pigs Infected Intracerebrally With Virulent Tubercle Bacilli[1]

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Up to the present time published data is not available concerning the effect of streptomycin in animals infected intracerebrally with virulent tubercle bacilli. The following is a preliminary report of such an experiment.

Twenty tuberculin-negative female guinea pigs weighing between 800 and 1,000 grams each were inoculated intracerebrally with 0.05 cc. of a culture containing 0.0001 mg. (dry weight) of a 7-day growth of H37Rv organisms in Tween-albumin liquid medium of Dubos (*1*). A small drill hole was made through the posterodorsal part of the skull, just to one side of the midline, and the organisms introduced by means of a tuberculin syringe and a ½" No. 26 gauge hypodermic needle.

Ten animals were kept as untreated controls; the other 10 were started on streptomycin[2] treatment immediately after inoculation. They were given 4,000 μg at 7:30 A.M., 12:30 P.M., and 5:30 P.M., and 6,000 μg at 10:30 P.M., or a total of 18,000 μg/day. The drug was given either intramuscularly or subcutaneously.

During the third week after infection, both treated and control animals began to show signs of brain damage manifested by paralysis of the hindquarters, loss of equilibrium, and occasional convulsions upon stimulation. The control animals began to succumb on the 17th day, and all except one were dead by the 22nd day. The latter animal died on the 92nd day and developed increasing paralysis of the hindquarters for one week prior to death.

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[1] This work was done under a grant-in-aid from the U. S. Public Health Service through the American Trudeau Society Streptomycin Program.

[2] Streptomycin was supplied through the courtesy of Dr. James Carlisle, of Merck and Company, Rahway, New Jersey.

On the 22nd day, at which time most of the treated animals were exhibiting the signs described above, the dose of streptomycin given to them was doubled, so that the animals received 36,000 μg/day. Within a few days the treated animals began to show improvement. The convulsive attacks and paralysis disappeared rapidly, the loss of equilibrium more slowly. Except for two animals which died of intercurrent disease on the 5th and 10th days after infection, the treated guinea pigs all remained well thereafter. After the 58th day, streptomycin treatment was stopped in one-half the group (4 animals), the remainder continuing on treatment. Those animals deprived of streptomycin showed a gradual return of paralysis of the hindquarters, which became progressively worse until time of death. All 4 animals died from the 98th to the 132nd day after infection (an average of 58 days after treatment was stopped).

TABLE 1

Guinea pig No.	Days of treatment with streptomycin	Days of life
1	None	21
2	"	17
3	"	92
4	"	19
5	"	19
6	"	19
7	"	18
8	"	19
9	"	22
10	"	21
1	5	5*
2	10	10*
3	58	132
4	58	127
5	58	109
6	58	98
7	173†	Living
8	173†	"
9	173†	"
10	173†	"

* Died of intercurrent disease.

† As of September 3, still living and being treated.

The 4 guinea pigs which were kept on treatment are still alive and well 173 days after infection.

All the treated animals responded to 5 per cent Old Tuberculin when tested intracutaneously 40 days after infection. The 4 remaining pigs are still skin positive at the time of writing this report, but the intensity of the reaction is declining. A summary of the time of death in relation to days of treatment is given in Table 1.

This experiment demonstrates that streptomycin administered intramuscularly or subcutaneously can effect inoculation tuberculosis of the brain in guinea pigs and cause improvement in the peripheral manifestations of such a lesion.

Previous experience in this laboratory has shown that an inoculum of attenuated or heat-killed tubercle bacilli equivalent to the infecting dose used in this experiment is not sufficient to produce skin hypersensitivity in guinea pigs. The results set forth in this paper, therefore, indicate that multiplication of the infecting organisms must have taken place in the guinea pigs despite the presence of streptomycin, and that it was only when the mechanisms of acquired immunity of the animal came into play that the disease was held under control by the drug. Further data on this subject will be reported from this laboratory (*2*).

The intracerebral method of infection offers a rapid means of testing the *in vivo* effect of antituberculosis drugs.

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"Acid Phosphatase" Reactions in Peripheral Nerves[1]

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The methods developed by Gomori (*4*) to reveal phosphatases in tissues have produced striking differentiations and are important additions to histologic technique. There is, for example, no simpler or more specific method for demonstrating the axis cylinders of nerve fibers than the acid phosphatase method following acetone fixation. The interpretation of the reaction, however, has presented difficulties so far as the nervous system is concerned. Heinzen (*5*) compared the acid phosphatase activity in the central and peripheral stumps of a series of transected nerves by standard biochemical methods and found increased activity in both stumps as compared with normal nerves. Histologic sections prepared by the Gomori method, on the other hand, showed a feeble reaction in the peripheral stump at a time when both stumps exhibited great activity *in vitro*. He suggested that the peripheral stump had suffered greater loss in staining capacity than the central between the time of removal of the tissue and the mounting of the sections.

Bodian (*3*) found the acid phosphatase activity in central stumps of transected nerves twice that of normal nerves and that of peripheral stumps 6 times as great. These biochemically determined differences could not be seen in sections prepared by the Gomori method. Bodian and Flexner then showed "that every step in the preparation of the histological sections for histochemical study sharply reduces the phosphatase activity as determined with the biochemical method."

We have studied the Gomori acid phosphatase reaction in peripheral nerves which had not been subjected to all the insults of histologic technique. Acetone-fixed nerves were teased in 80 per cent alcohol and transferred to the glycerophosphate-lead reagent buffered at pH 4.8 with molar acetate. After 2–18 hours at 38° C. they were washed thoroughly in distilled water and the lead visualized with ammonium sulphide.[2] Under these conditions the peripheral stump of a cat's sciatic nerve 16 days after transection appeared to the naked eye to be as intensely stained as the central stump. Under the microscope the normal fibers of the latter showed the usual precise staining of the axones; as in the normal controls, nuclei could rarely be demonstrated. Peripherally, where invasion of regenerating fibers had been prevented, all

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[1] Aided by a grant from the Dr. Wallace C. and Clara A. Abbott Memorial Fund of The University of Chicago.

[2] Rinsing with 1 per cent aqueous acetic acid before the sulphide did not materially alter the picture.

types of nuclei reacted strongly, as did the degenerating remains of axones and myelin. The neuroma presented the same picture with many nuclei and, in addition, had the regenerating fibers differentiated in all detail. When strands of these same nerves were extracted with distilled water either *before* or *after* the glycerophosphate-lead treatment, the nuclei were the first to suffer. After extractions of 16–24 hours, which left the axones stainable, the nuclei no longer reacted at all. There is thus a differential susceptibility to washing with water which appears to be greater in paraffin material cut into thin sections, such as Heinzen used, than it is in strands of teased fibers.

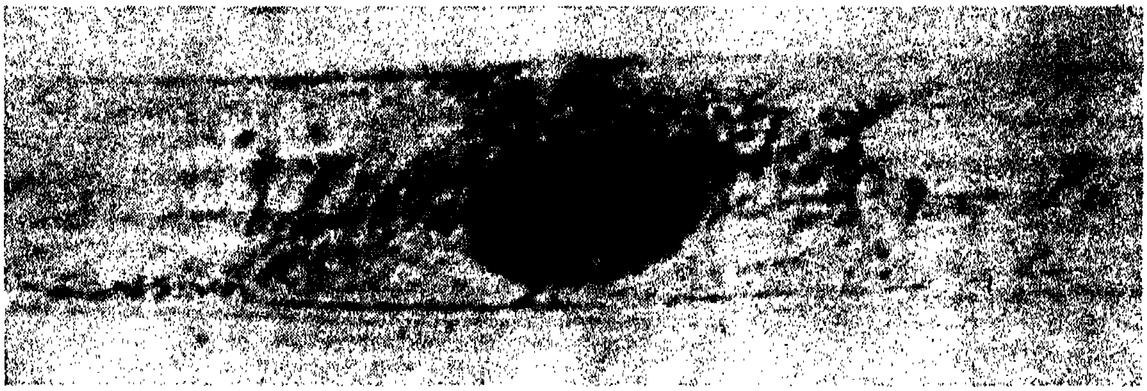

FIG. 1 Photomicrograph of cell of Schwann, viewed from above, showing stained granules in nucleus and cytoplasm. The cell appears irregularly branched. (From a bit of fresh sciatic nerve of a kitten placed directly into the glycerophosphate-lead reagent and incubated for 1½ hours. Photographed by R. D. Bensley from a teased nerve mounted in glycerine. (X 2,000.)

The water extractions provide an explanation of his discrepant results. They indicate that both enzymes and lead phosphate can readily be removed from the tissue. This would necessarily mean that both can move about freely within the tissue and that the Gomori method cannot be relied upon to furnish evidence as to the localization of acid phosphatase activity within the cell.

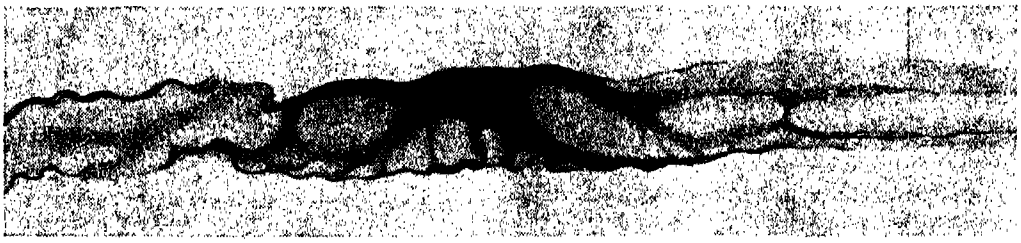

FIG. 2 Schwann cell in profile showing anastomosing cell processes which, when viewed on edge, appear as dark lines. (From the same nerve as Fig. 1 but incubated for 23 hours. Drawn by Agnes Nixon from a teased preparation in glycerine. (X 620.)

When acetone fixation was omitted and bits of fresh normal nerves were snipped off and placed directly into the glycerophosphate-lead reagent, the microscopic picture differed significantly in that the various types of nuclei were the dominant features. In the course of 25 minutes incubation at 38° C. an occasional nucleus appeared, and some cytoplasmic granules of the Schwann cells were sharply stained; a few nucleoli were darker than other structures. By 45 minutes practically all nuclei of sheath cells appeared filled with granules of uniform size, smaller than the nucleolus, which was darker. The cytoplasm of the Schwann cells could be followed as it spread irregularly over the larger myelinated fibers, thanks to the staining of small granules. Fig. 1 shows a Schwann cell after 1½ hours of incubation.

We have obtained this result in various normal nerves of the cat, rabbit, rat, guinea pig, macaque monkey, and man.[3] The promptness and regularity with which the Schwann cells and the nuclei of other sheath cells react suggest that we are dealing with a highly specific reaction. There is no differentiation if glycerine is substituted for the glycerophosphate, if the fresh tissue is boiled for 5 minutes in distilled water,[4] or if NaF is added to the reagent in a concentration of .005 M. If the reactions in fresh tissue are indeed indications of intracellular phosphatase activity, there is no reason for concluding that the various observed granules are actual sites of enzymatic reactions. The reaction requires at least 25 minutes to attain microscopic visibility, and this affords ample time for the shifting of both enzymes and lead phosphate within the protoplasm. In this connection the findings of Owens and Bensley (7) on the drift and segregation of colloid particles in cells are particularly significant.

In the cat the cytoplasm of the Schwann cells develops a dark tinge in addition to the granules in the course of 18–24 hours of incubation. Cells such as those of Figs. 1 and 2 are present on every myelinated fiber midway between the nodes of Ranvier. The pictures resemble those obtained by Nemiloff

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[3] We are indebted for the human material to D. B. Phemister and Alex Brunschwig.

[4] This method of destroying phosphatase activity was suggested to us by W. L. Doyle.

(*6*) in spinal root fibers of the cat stained intravitally with methylene blue. In our material it is occasionally possible to follow the cell processes to the nodes, where there is usually an accumulation of cytoplasm studded with fine granules. Various appearances like the spiny bracelets of Nageotte are sometimes differentiated. In time, the nuclei become opaque (cf. Fig. 2) through the enlargement and fusion of the granules.

Another phenomenon appears in the fresh tissue, and as promptly as the staining of the sheath cells. The ends of the axones react intensely where they were injured by pressure or by electrical changes induced by metal instruments in the fresh tissue. Similar reactions to injury occur with methylene blue in living animals (*2*). The lead sulphide staining at sites of injury always occurs after boiling fresh tissues and has nothing to do with phosphatases. In addition, the normal myelinated fibers assume a uniform yellow tint, both in fresh and boiled material. This is presumably due to a diffuse adsorption of lead. That it is not due to staining with sulphides is indicated by the fact that a similar uniform staining occurs if the lead is visualized by means of a freshly prepared unoxidized aqueous solution of hematoxylin.[2]

If dry ice is applied to a living nerve *in situ*, all axones are shriveled. When the frozen tissue is gradually thawed in chilled glycerophosphate-lead reagent and then incubated, all axones are as intensely stained as in acetone-fixed material. In addition, all nuclei react as in fresh tissue.

In 1906 R. R. Bensley (*1*) showed that the supposed histochemical test for organically bound phosphorus was nothing more than a staining reaction. The Gomori phosphatase reactions likewise involve substitutions; the substance visualized is not the substance sought. Adsorption and diffusion may play significant roles. Until it has been shown that they do not, the specificity of the reactions must remain in doubt. It may be that both boiling and fluorides do more than merely inhibit enzymatic activity.

Certain findings indicate that the histologic acid phosphatase reactions are unreliable: (1) Both enzymes and lead phosphate can be leached out of, and hence moved about within, fixed tissues. This deprives the method of value for the localization of enzymatic activity. (2) All nuclei and the Schwann cell cytoplasm react promptly when fresh nerves are placed directly into the glycerophosphate-lead reagent. This does not occur after acetone fixation. (3) The axones of fresh myelinated fibers do not react unless they have been injured. Axones shriveled by freezing or acetone react strongly except at the nodes of Ranvier. (4) The reaction of injured tissue after the destruction of enzymatic activity shows that under certain conditions the lead of the reagent can be specifically adsorbed.

We are continuing our efforts to obtain differentiations in peripheral nerves with reagents which simulate the glycerophosphate-lead reagent but which contain no phosphate.

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[2] We owe this test to R. R. Bensley.

Polydactyly and Limb Duplication Occurring Naturally in the Tiger Salamander, *Ambystoma tigrinum*

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Few cases of polydactyly and limb duplication occurring in nature in *Ambystoma* have been reported in the literature (*8*). On the other hand, limb duplications following transplantation procedures in the laboratory are very well known from the work of Harrison and his students. Such anomalies may result from a variety of operative treatments, including the division of the limb rudiment (*11*), orthotopic and heterotopic limb transplantations (*2, 3, 5, 7, 9, 12*), and induction of supernumerary limbs by implantation of foreign tissue (*1, 4, 6*). The experimental production of limb duplications by methods other than transplantation techniques is still an unexplored field.

TABLE 1

Polydactyly and Limb Duplications in *Ambystoma tigrinum**

Animal	Left hind limb	Right hind limb	Remarks
2	Normal	8 digits	Metamorphosed
3	6 digits	6 "	
4	Normal	6 "	
5	Main limb with 6 digits; *extra limb* with 12 digits	Main limb normal; small *extra limb* with 2 digits	
6	8 digits	8 digits	
7	Normal	7 digits plus 1 very small bud	Questionable mirror-image symmetry
8	Main limb with 7 digits; *extra limb* with 7 digits	8 digits	Questionable mirror-image symmetry
9	6 digits	6 "	
10	Normal	8 "	
11	6 digits	6 "	
12	9 "	9 "	
13	Normal	8 "	
14	Main limb normal; *extra limb* with 7 digits	7 "	
15	6 digits	8 "	
16	9 "	Main limb and *extra limb* fused with a total of 14 digits	
17	9 "	6 digits plus 1 small bud	Metamorphosed
18	6 " plus 2 buds	6 digits	"
20	Normal	6 "	
21	6 digits	Normal	

* Animals 2 through 18 collected as larvae, 1946 (117–144 mm. in length); 20 and 21 collected as adults, 1947.

The anomalies reported here in the tiger salamander, *Ambystoma tigrinum*, represent the first recorded case of mass polydactyly occurring naturally. The abnormal animals were collected in Muskee Lake (altitude, 8,300 feet) approximately 15 miles west of Boulder, Colorado. This and the surrounding lakes have been extensively studied in recent years, but the first polydactylous individuals were found in October 1946 (17 larvae) and in April and May 1947 (2 adults). The percentage of abnormal individuals collected in the fall of 1946 was extremely high—of 19 animals collected, 17 showed polydactyly and limb duplication in some degree.

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[1] Now at the University of Illinois, Department of Zoology.

The abnormalities range from one extra digit to a complete extra appendage with supernumerary toes. The condition is found in both sexes, on either one or both sides of the animal, and is always limited to the hind limbs. A summary of the abnormalities occurring in larvae and adults collected both seasons is presented in Table 1. Outline drawings of polydactylous and duplicated limbs from three larvae are shown together with a normal limb for comparison (Fig. 1). The anomalous condition is not altered by metamorphosis of the animals from the larval to adult stage. Pigmentation of the extra digits is normal, and they appear in most cases to be fully functional. However, the supernumerary limbs seem to be more of an encumbrance than an advantage to the salamanders.

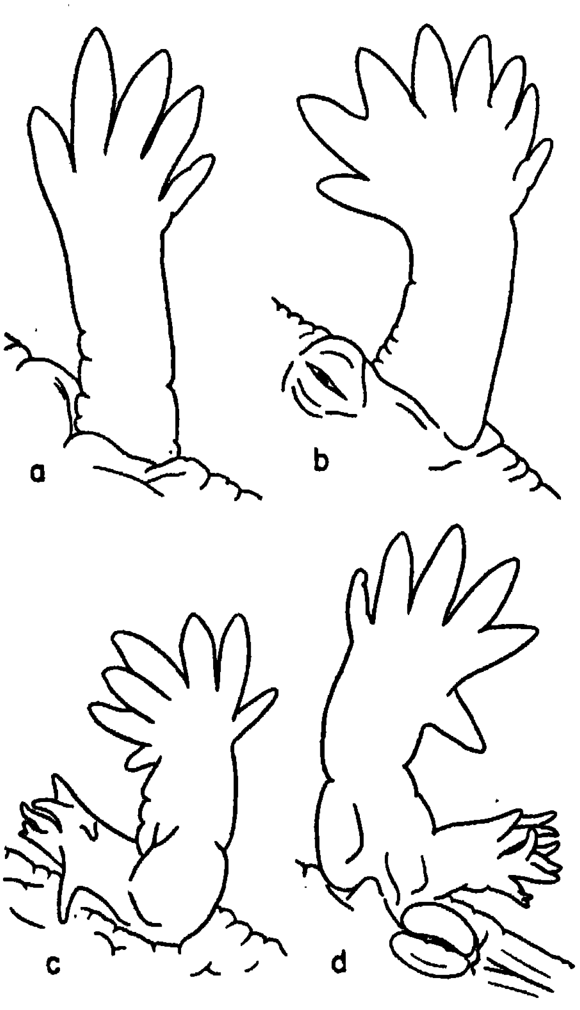

Fig. 1. Polydactylous hind limbs of *A. tigrinum* (2½×): (a) normal left limb, spec. #10, dorsal view; (b) 8-toed right limb, spec. #10, ventral view; (c) extra polydactylous left limb, spec. #8, lateral view; (d) left limb duplication, spec. #5, ventral view.

Polydactyly and limb duplications induced by transplantation methods usually show mirror-image symmetry between the supernumerary and the normal limb, although asymmetrical exceptions have been noted, particularly by Swett (*10*). This symmetry holds for duplications in both the dorsoventral and the anteroposterior planes and is due, according to Harrison (*6*), to the development of more than one growth center, the main center reversing the symmetry of an adjacent center. It is of significance to point out that in the naturally occurring polydactylous series noted in this paper there are only two cases—and they are doubtful—of mirror-image symmetry (Fig. 2). The right hind limb of animal #7 has 7 well-formed toes plus a small bud, and we may be dealing with a duplication involving a reversal of symmetry. In animal #8 the supernumerary left limb can be interpreted as dorsoventral mirror-image symmetry, with, however, considerable modification due to different growth rates of the several digits. These two cases of questionable mirror-image symmetry are exceptions in the present series; most of the limbs show no such symmetry but rather appear to have added extra digits in series, adjacent to digit #5, as clearly shown in the right hind limb of specimen #10. (Fig. 1b).

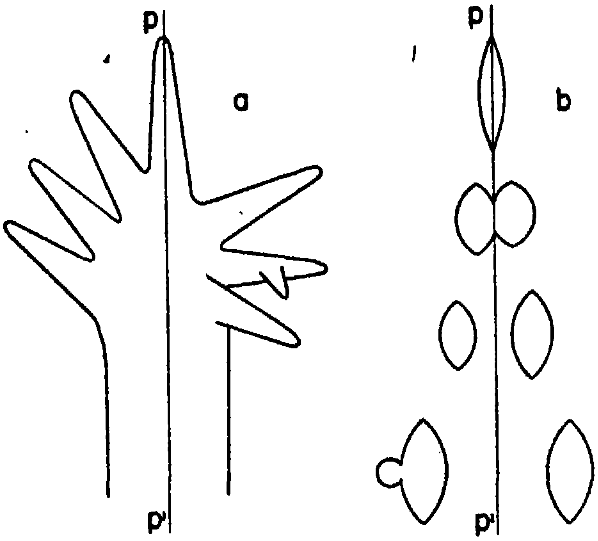

Fig. 2. Possible mirror-image symmetry in limb duplications: (a) anteroposterior symmetry in right limb of spec. #7; (b) dorsoventral symmetry in extra limb of spec. #8 (p-p' represents the plane of symmetry).

Investigations of these polydactylous salamanders are in progress to determine the nature of the genetic background and those environmental factors, e.g. cold shock, which might have contributed to the widespread occurrence of these anomalies within a limited *Ambystoma* population.

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Antibiotic Activity of Subtilin and Streptomycin in the Presence of BAL[1]

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The sulfhydryl groups in enzymes have been stressed by some authors as responsible for the attack of antibiotic (*4*) and metallic antiseptics (*9*) on microorganisms as well as for the arsenic poisoning of mammalian tissues (*1*). The inactivation of antibiotic substances by sulfhydryl compounds in certain cases (*6, 7*) and the effectiveness of using BAL as an antidote to arsenic and other heavy metal poisoning (*3, 11, 14*) gave support to this postulation.

BAL (2,3-dimercaptopropanol), a simple compound with two sulfhydryl groups, has been reported by Johnson, *et al.* (*12*) to be able to inactivate bacitracin, an antibiotic produced by a strain of *B. subtilis*. Subtilin, which is also produced by a strain of *B. subtilis*, has an antitubercular activity *in vitro* comparable to that of streptomycin. This property of subtilin is being carefully studied in this laboratory. Chin (*5*) has reported that sodium chloride does not alter the antibiotic action of subtilin. Since Loo, *et al.* (*13*) and Berkman, *et al.* (*2*) have reported that sodium chloride antagonized the antibiotic action of streptomycin, which was dissimilar to the case of subtilin, it is of interest to know whether sulfhydryl compounds which have been known to inactivate streptomycin (*7, 16*) affect subtilin similarly or dissimilarly. While experiments on other sulfhydryl compounds are still in progress, the study on BAL has brought about interesting results.

This study has been made upon four strains of *Mycobacterium*, two human strains (H37Rv and R1), one bovine, and one nonpathogenic fast-growing #599, and a strain of *Micrococcus lysodeikticus*.[3] *M. lysodeikticus* was cultured in beef-heart infusion medium, and tests were also made in the same medium. Mycobacteria were cultured and tested in Dubos medium (*8*). Since BAL at a dilution of 1:10,000 has been found to inhibit the growth of mycobacteria, a dilution of 1:100,000 was used. The results, as shown in Table 1, indicate that BAL was synergistic with subtilin in bacteriostatic action on all strains of mycobacteria studied but not on *M. lysodeikticus*. The antibiotic action of streptomycin was affected in various ways. The bacteriostatic activity against pathogenic mycobacteria was potentiated, though not as remarkably as in the case of subtilin, whereas against the nonpathogenic strain #599 its action was not affected. Streptomycin was inactivated in the presence of BAL against *M. lysodeikticus*.

The mechanism of synergism between subtilin and BAL is entirely unknown. A similar potentiation, though to a lesser degree, of the action of streptomycin against a pathogenic mycobacterium is remarkable and may reflect that BAL itself acted somehow on the organisms so that they were rendered more susceptible to antibiotics.

Shwartzman (*15*) has reported synergism between methionine, methionine sulfoxide, and threonine and penicillin and suggested that these amino acids reverse the action of other antagonistic substances. The same explanation is unlikely and not applicable to the case of BAL, which potentiates both subtilin and streptomycin similarly.

BAL has been known to attack enzyme systems (*17*). Is it possible that some enzyme systems of mycobacteria are susceptible to BAL? Since BAL has a structure very similar to that of glycerol, which is utilized especially by pathogenic mycobacteria as a source of carbon (*18*), and it has been found to inhibit the growth of these organisms at 1:10,000, does it mean that Fildes' theory (*10*) of biochemical antagonism may be extended to the field of nonessential metabolites? Even if the action of BAL on a mycobacterium can thus be explained, the question of synergism remains to be elucidated. An elucidation of this mechanism is practically impossible at present when so much about the metabolic processes of mycobacteria remains unknown and is awaiting further study.

TABLE 1

EFFECT OF BAL ON THE BACTERIOSTATIC LEVEL OF SUBTILIN AND STREPTOMYCIN

Organism	Effective level of subtilin		Effective level of streptomycin		Conc. of BAL
	with BAL	without BAL	with BAL	without BAL	
Pathogenic *Mycobacterium*					
Human H37Rv	$1:32 \times 10^6$	$1:2 \times 10^6$	$1:32 \times 10^6$	$1:8 \times 10^6$	$1:10^5$
Human R1	$1:64 \times 10^5$	$1:4 \times 10^6$	$1:64 \times 10^6$	$1:16 \times 10^6$	$1:10^5$
Bovine	$1:128 \times 10^6$	$1:32 \times 10^6$	$1:64 \times 10^6$	$1:32 \times 10^6$	$1:10^5$
Nonpathogenic *Mycobacterium* #599	$1:16 \times 10^6$	$1:8 \times 10^6$	$1:32 \times 10^6$	$1:32 \times 10^6$	$1:10^5$
Micrococcus lysodeikticus	$1:16 \times 10^7$	$1:16 \times 10^7$	$1:2 \times 10^6$	$1:8 \times 10^6$	$1:10^4$

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[1] The authors are indebted to the Biochemical Division, Western Regional Research Laboratory, U. S. Department of Agriculture, Albany, California, for the supply of subtilin; to Eli Lilly & Co., Indianapolis, Indiana, for the supply of streptomycin and partial support of the work.

[2] Lilly Research Fellow in Pharmacology.

[3] H37Rv was obtained from the standard culture depot, National Tuberculosis Association; R1, bovine, and #599 strains, from the Lilly Research Laboratories; *M. lysodeikticus*, from H. B. Woodruff.

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Inadequate Maternal Nutrition and Hydrocephalus in Infant Rats[1]

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Richardson and Hogan (*1*) observed hydrocephalus in infant rats as the result of feeding an inadequate diet to the mother. In this abnormality the head is dome shaped and greatly enlarged. The brain cavity is filled with serum and transmits light readily. In some cases the eyes are abnormally small and muscular incoordination usually develops if the affected rat survives long enough.

In order to demonstrate more conclusively that hydrocephalus is caused by a nutritional deficiency it seemed desirable to produce the abnormality in an unrelated colony of rats. The colony at the Texas Station, which has been maintained for more than 10 years without the introduction of any new strains, was suitable for such a study. A total of 38 females have received Diet A, which is essentially the same in composition as that used by Richardson and Hogan. This diet is composed of casein (acid washed), 25 grams; Cerelose, 57 grams; wood pulp, 3 grams; salts, 5 grams; lard, 10 grams; choline chloride,[2] 0.1 gram; inositol,[2] 0.01 gram; p-aminobenzoic acid,[2] 0.05 gram; vitamin A, 3,000 I.U.; vitamin D, 425 I.U.; α-tocopherol,[2] 2.5 mg.; Menadione,[2] 2.5 mg.; thiamine chloride,[2] 1.0 mg.; riboflavin,[2] 1.0 mg.; pyridoxine hydrochloride,[2] 1.0 mg.; calcium pantothenate,[2] 4.0 mg.; niacin,[2] 5.0 mg.; and biotin,[2] 0.02 mg.

Some of the experimental females were from mothers which received a stock diet and others were from mothers which received a synthetic diet, but in every case they received Diet A from 28 days of age until the observations were discontinued. A female was observed until it was evident that she would not produce any additional young.

A total of 10 young have developed typical hydrocephalus. The incidence was 1.5 per cent, or approximately the same as that given in the earlier report. None has occurred in the offspring of females which received a stock diet composed of natural feedstuffs. The hydrocephalus in 5 of the 10 young was identified at birth. It was identified again in these same young when they were 10 days old by observing the transmission of light through the brain cavity, and finally by autopsy. It was not identified in the other 5 until they were about 10 days old. Twelve additional young appeared to be hydrocephalic at birth, but none of these survived longer than two days, and these early identifications have not been entirely reliable.

Richardson and Hogan observed one case of hydrocephalus in the offspring of a mother which received 5 per cent of dried yeast in the diet. This observation suggested that a small amount of yeast in the diet would furnish very little, if any, of the factor which prevents hydrocephalus, and at the same time it would supply sufficient pteroylglutamic acid for normal reproduction.

Intestinal synthesis of some unrecognized factor might decrease the incidence of hydrocephalus, even though the diet itself was low in this factor. The addition of a sulfonamide to the diet would decrease this intestinal synthesis and thus increase the incidence of the abnormality. In order to test this possibility 12 females were given Diet B, which is the same as Diet A with 2 per cent of dried yeast and 1 per cent of sulfasuxidine substituted for equal amounts of Cerelose. So far, these 12 females have produced 92 young and none has been hydrocephalic. These data are too insufficient to be conclusive, but they indicate that the addition of sulfasuxidine to the diet does not increase the incidence of the abnormality under these conditions.

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[1] Authorized for publication as technical article No. 1057, Texas Agricultural Experiment Station.

[2] Kindly supplied by Merck and Company, Rahway, New Jersey.

Effect of Flavonols on *Clostridium botulinum*

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While conducting experiments on the microbial spoilage of vegetables, the authors found that, although asparagus is readily attacked by many organisms, it is a poor medium for growth of *Clostridium botulinum*. The thought was entertained that the flavonol compound described by Campbell (*1*) as occurring plentifully in asparagus, and subsequently shown by DeEds and Couch (*2*) to be rutin, might be responsible. Following the report by Naghski, Copley, and Couch (*3*) on the suppression of *Staphylococcus aureus* by quercetin, an aglucone derivative of rutin, tests were made to determine the action of rutin, quercetin, and quercitrin[2] (a rhamnoside of quercetin) on *Cl. botulinum*. Three sets of flasks, each flask containing 15 grams of green peas and 15 ml. of corn steep-casein medium, were inoculated with a mixture of approximately 1,000 detoxified spores of *Cl. botulinum*, Types A and B, per flask. The reaction of the medium was pH 6.60. One flask in each set was left untreated as control. Weighed amounts of rutin, quercetin, and quercitrin were added to give concentrations ranging from 60 to 160 p.p.m. The flasks were heated for 5 minutes at 100° C. and incubated anaerobically for 10 days at 23° C. Sterile filtrates were then prepared and tested for toxin by inoculating 0.20-ml. amounts into mice.

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[1] Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[2] Thanks are due F. DeEds, Pharmacology Laboratory, and J. F. Couch, Eastern Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, for furnishing quercetin, quercitrin, and rutin for use in these experiments.

Rutin in concentrations up to 1,000 p.p.m. did not prevent growth of *Cl. botulinum* or interfere with toxin production. Quercitrin was effective only in concentrations of about 1,000 p.p.m. The action of quercetin was, however, well marked, amounts of from 80 to 160 p.p.m. in the course of several trials preventing toxicity. In one experiment, using corn steep-casein medium alone, no toxin was demonstrated in a concentration of quercetin of 20 p.p.m. The action is antibacterial, only an occasional cell appearing in smears after incubation. Concentrations of quercetin as high as 1,000 p.p.m. failed, however, to inactivate preformed toxin of *Cl. botulinum* in 72 hours.

The limited action of quercitrin in preventing growth of *Cl. botulinum* in the present experiment may have been due to the presence in the sample of a small amount of quercetin. Also, it is considered possible that in certain samples of asparagus enough quercetin may naturally be present to check growth of *Cl. botulinum*. As lately shown by Naghski, Copley, and Couch (*4*), the compound is antagonistic to ***Brucella abortus*** and ***Aerobacillus polymyxa*** as well as to staphylococci. Whether anaerobic organisms in addition to *Cl. botulinum* are affected is at present uncertain.

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IN THE LABORATORY

A Flower Marker for Plant-breeding Operations

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Wherever controlled cross-pollinations are made on a large scale, any simplification of the method of marking flowers is desirable. String tags, which are often used for this purpose, are tedious to apply, especially to smaller flowers; require pencil or ink marking; and are susceptible to weather damage, which may even obliterate identification markings.

The requirements for this type of marker have been met economically by small pieces of "Twist-Ems"—a product devised for tying plants and for bunching root vegetables, consisting of a wire strand sealed by a waterproof adhesive between two narrow strips of heavy paper. These markers, used here for periods of three to five months, have proved to be quite weather resistant; moreover, they have been so durable that it has been possible to salvage them for satisfactory use in a second season.

When used to tag pollinated tomato flowers, "Twist-Ems" are cut into inch lengths. Each piece is folded at one end, placed on the flower so that the pedicel lies within the fold, and then folded in the same direction at the other end (Fig. 1). The second fold serves to lock the first one and thus prevents loss of the marker. Any identification markings can be protected from weathering by keeping them inside the folds. Although firmly attached, the marker will not prevent further growth; the wire of "Twist-Ems" is so easily bent that it does not constrict the developing pedicel.

Markers intended for various crosses can be distinguished by painting them different colors in fade-proof lacquers. Two or more colors can be applied in various combinations to the same marker in longitudinal or oblique stripes, thereby increasing greatly the number of different identifiable markers. Various combinations of letters or numbers (dates if desired) can be printed on the strips by means of an improvised rotary rubber stamp. The parents of a particular cross combinaiton can then be identified by reference to a key to the color or number combinations.

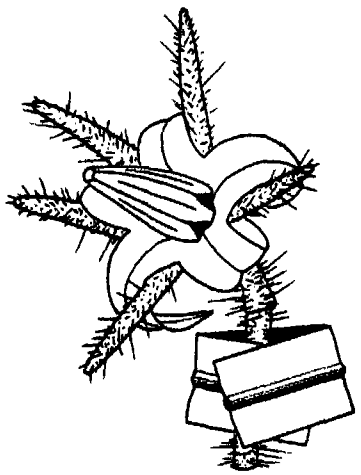

Fig. 1. Diagram of the flower marker placed on the pedicel of a tomato flower.

These markers have been used successfully for tagging flowers of tomatoes, asparagus, and cabbage as well as in marking stems and petioles of particular ages where later identification was needed. Many other uses in biological research might be found where large-scale marking is required.

Mounting of Dermatological Material With Synthetic Resins

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In order to have available, especially for teaching and investigative purposes, permanent mounts of cleared, unstained, fungus-infected materials, trials have been made with the various mounting materials currently available. Colorless nail polish has also been used. To date, one of the most satisfactory of these mounting materials has been the Permount (obtainable from Fisher Scientific Company, Pittsburgh). After this report was prepared, the recent work of Barghoorn (*1*) on phenol formaldehyde and vinyl resins was found. Permount has been reported merely as a 60 per cent solution of pinone polymers. Without any preparation, the hair or scales of skin are put on a slide covered with a thin coating of the solution of the resins, covered with a cover slip pressed to remove bubbles of air. The solvent may serve to clear the tissue; the plastic, to preserve it. The specimens are available for immediate examination (Fig. 1). Over a period of a year the specimens have shown no discoloration or distortion. The solution has been used also to mount satisfactorily *Simulium*, *Pulex irritans*, *Phthirus pubis* with ova, *Pediculus capitis* and *corporis* and *Cimex lectularius*. For the preservation of larger specimens, the technics of Sando (*3*), Strumia and Hershey (*4*), and Kampmeier and Haviland (*2*) are preferred.

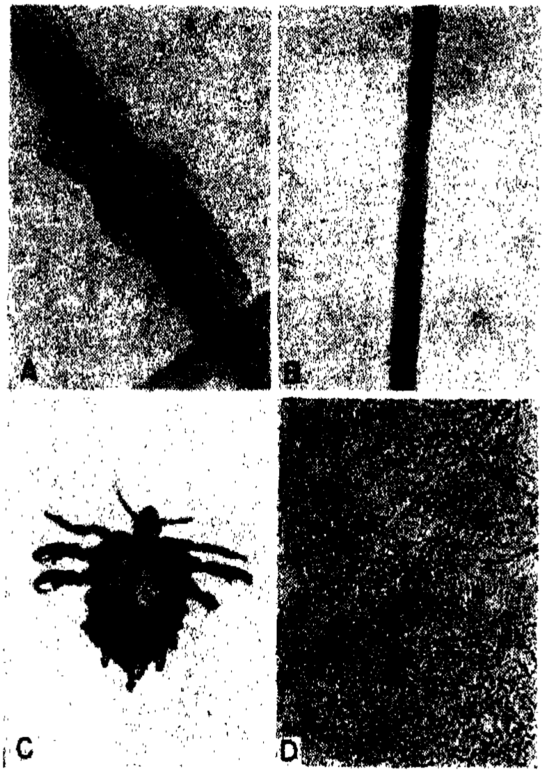

FIG. 1. Some specimens in a dermatological laboratory mounted directly in Permount: A.—hair infected with *M. audouini* (× 700); B.—hair acquired canities at zone of depigmentation (× 160); C.—*Phthirus pubis* (× 35); D.—skin infected with *M. audouini* (× 700).

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Polytetrafluoroethylene for the Prevention of "Bumping" From Superheating of Boiling Fluids

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Polytetrafluoroethylene, recently developed as a commercial plastic under the trade name of "Teflon,"[1] is extremely inert chemically, being unattacked by hot or cold acids or alkalis, or by chemical oxidizing agents; appears to be insoluble in all aqueous, organic, and silicone fluids; is attacked by molten sodium or potassium; is not wet by aqueous fluids or by many organic fluids; and can be cleaned in strong acid cleaning solutions or in alkali.

A sample piece of "Teflon" sheeting 0.040 inch thick was kindly supplied by the DuPont Company over a year ago. While cleaning some of the material in hot, 30 per cent sodium hydroxide solution it was noted that the solution boiled smoothly for many hours without bumping. Since then, small bits of polytetrafluoroethylene have been used routinely to prevent bumping in boiling fluids. The material has worked with uniform success with alkaline and acid solutions except as noted below, and with numerous organic fluids, including aniline, propionic acid, decahydronaphthalene, morpholine, ethylene dichloride, chloroform, benzyl alcohol, amyl acetate, ethyl alcohol, acetone, and many others.

It has not been very satisfactory as an antibumping agent for Kjeldahl digestions, probably because it floats in this heavy acid mixture.

It is striking that polytetrafluoroethylene retains its antibumping action for many hours—probably indefinitely. Pieces can be used repeatedly without evidence of deterioration.

One is tempted to theorize that antibumping action is probably related closely to nonwetability. Perhaps only an immersed surface not wet by the fluid brings about a satisfactory liquid boundary from which vapor molecules can escape readily. This might explain the well-known fact that glass beads function as satisfactory antibumpers when freshly added to an alkaline solution, when perhaps they are not perfectly clean and hence may have surfaces not wet well by water, whereas after a short time they cease functioning efficiently, presumably after they have been cleaned off by the solution and rendered wetable. Polytetrafluoroethylene, however, retains its nonwetting properties when perfectly clean.

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[1] Manufactured by E. I. duPont de Nemours & Company.

Author Index

A

Aaron, Isador, 62
Abelson, P. H., 69
Abrams, Duff A., 617
Abramson, Harold A., 316
Adams, Walter S., 196
Adsuar, José, 130
Ahrens, L. H., 268
Aird, R. B., 64
Aldous, J. G., 109
Aldrich, L. B., 225
Allen, Leah B., 228
Alture-Werber, Erna, 494
Ames, Adelbert, Jr., 600
Andersen, A. A., 644
Anderson, Hamilton H., 643
Anderson, Jane Collier, 104
Andrews, E. A., 145
Anlyan, A. J., 66
Appleton, Edward, 17
Aragon, G. T., 265
Armstrong, W. D., 403
Ash, Roy P., 528
Ast, David B., 292
Atlas, Leon T., 636
Aurand, L. W., 493

B

Baker, Burton L., 454
Baldwin, Francis Marsh, 376
Baldwin, R. R., 317
Ballew, Julius R., 324
Bandelin, F. J., 426
Banerjee, Sachchidananda, 128
Banks, Harvey W., Jr., 637
Banvard, Janet, 188
Barghoorn, E. S., 299
Barnett, Henry L., 401
Barron, Donald H., 160
Barry, G. T., 394
Bartelmez, G. W., 639
Bartelstone, J. H., 132
Barton, Harry C., 319, 589
Bartz, Quentin R., 417
Bennett, H. Stanley, 646
Bennett, Ralph E., 551
Bennett, Rawson, 283
Benninghoff, William S., 325
Bensley, Sylvia H., 639
Bent, Henry E., 374
Bernstein, Richard B., 498
Berry, J. A., 644
Bessey, Otto A., 600
Betts, Gilbert L., 93
Beveridge, W. I. B., 324
Biely, Jacob, 40
Bingham, Walter V., 155
Birkeland, J. M., 587
Bishop, David W., 588, 641
Blackwelder, Richard E., 315
Blakemore, Arthur H., 68
Blau, M., 400
Bloch, Edward H., 431
Bloch, Robert, 320, 476
Bok, Bart J., 341
Bolin, Donald W., 451
Bonham, Kelshaw, 245
Book, Lucille, 451
Bouldin, Ralph F., 527
Bragdon, Merle H., 602
Bragg, Arthur N., 166
Branson, Herman, 404, 637
Brasch, Frederick E., 102
Brink, R. A., 547
Brody, Daniel A., 595
Broh-Kahn, Robert H., 148
Brooks, Matilda Moldenhauer, 320
Brooks, Maurice, 46
Brown, Charles Harvey, 54
Brown, Gordon C., 43
Brown, James W., 266
Brubach, Howard F., 18
Bruns, Paul, 427
Buck, John B., 551
Bueno, P., 346
Bullock, T. H., 483
Burkenroad, Martin D., 290
Burkholder, Paul R., 417
Burrell, Jean I., 36
Byer, Albert J., 134

C

Cannon, Mott D., 597
Caplovitz, Coleman D., 243
Carlson, A. J., 616
Carlson, Arthur S., 523
Carolus, R. L., 590
Carpenter, Esther, 621
Casals, J., 267
Caspe, Saul, 371
Castor, John G. B., 43
Cayer, David, 448
Chace, Fenner A., Jr., 611
Chandrasekhar, S., 213
Chapman, W. M., 553
Chesler, Annette, 345
Chin, Yin-ch'ang, 643
Chinard, Francis P., 71
Cholak, Jacob, 63
Chu, C. H. U., 70
Church, George L., 252
Cohn, Maurice L., 446
Cole, R. K., 379
Coleman, A. J., 226
Colmer, Arthur R., 253
Cooperstein, S. J., 471
Copisarow, Maurice, 241, 290
Corper, H. J., 446
Corwin, J. F., 353
Coulter, L. L., 590
Court, A., 225
Cowdry, E. V., 479
Craddock, Charles G., Jr., 473
Craig, L. C., 394
Cunningham, Eileen R., 609
Curtiss, L. F., 302
Cutler, Elliott C., 619

D

Dahl, A. I., 428
Daniel, Robert S., 398
Davidson, Benjamin, 371
Davies, M. C., 273
Davis, H. C., 597
De, S. S., 421
de Beer, Edwin J., 328
Decaneas, D., 367
Deichmann, Elisabeth, 611
DeLay, P. D., 545
DeMottier, Jeanne, 644
Derow, Matthew A., 347
Desikachar, H. S. R., 421
Dicker, S. E., 127
Diller, Irene Corey, 348
Dodds, Mary L., 67
Dodson, Louis B., 637
Doetsch, Raymond N., 524
Donaldson, Lauren R., 245
Douglass, Irwin B., 528
DuBois, K. P., 370
Dunning, J. M., 415
Dutcher, R. A., 294

E

Ebert, Robert H., 476
Eble, T. E., 373
Editorial Board, Monograph on the Chemistry of Penicillin, 503
Egan, J. P., 333
Ehrlich, John, 417
Eiber, Harold B., 494
Eichel, B., 471
Eliot, Theodore S., 431
Epple, Robert, 601
Eyster, H. C., 265

F

Fan, C. S., 291
Fano, U., 87
Farber, Sidney, 619
Felber, Irma M., 251
Fellers, Francis X., 401
Felsen, Joseph, 275
Felts, W. M., 41
Fenton, William N., 539
Finn, Sidney B., 292
Fischbach, Henry, 373
Fischer, Albert, 127
Fischer, E., 146
Fishman, Jacob B., 402
Fishman, William H., 66
Foley, George E., 423
Foreman, W. W., 277
Fosberg, F. R., 250
Frank, Cecil, 474
Frankstein, S. I., 242
Frantz, Ivan D., Jr., 544
Fried, M. I., 19
Friedman, Meyer, 341
Fritz, S., 225
Fults, Jess L., 37

G

Gain, J. F., 525
Galtsoff, Paul S., 342
Gardner, W. U., 270
Gehauf, B., 274
Genetics Conference, Committee on Atomic Casualties, National Research Council, 331
Gerard, R. W., 23, 289
Germann, Frank E. E., 181
Gilchrist, Raleigh, 112
Goldman, Leon, 646
Goldman, Morris, 42
Goncalves, Jose M., 369
Goodale, H. D., 12
Gordon, F. B., 549
Gornall, A. G., 108
Goss, G. C. L., 375
Graff, Samuel, 68
Graham, Eugenia B., 347
Graham, Robert, 92
Gray, C. T., 587
Green, E. L., 11, 154
Greenberg, David M., 271
Greenstein, Jesse P., 369
Grettie, D. P., 277

Grim, J. M., 354, 430, 502
Grimball, E. L., Jr., 594
Grosse, A. V., 88
Gudger, E. W., 71
Guest, M. Mason, 41
Guilford, J. P., 279
Gunter, Gordon, 472
Gurchot, Charles, 490
Guss, Cyrus O., 528
Guthrie, John D., 344

H

Haas, Otto, 144
Haley, Thomas J., 151, 350
Hall, Ivan C., 170
Halpern, G. R., 40
Hamilton, Robert, 641
Hamly, D. H., 169
Hand, I. F., 225
Hardy, Frank, 40
Harlow, Harry F., 300
Harper, Harold A., 319, 589
Harrell, Thomas W., 26
Harris, Henry C., 398
Harrison, J. Hartwell, 619
Harrison, Preston E., 188
Harrison, Ross G., 533
Hartmann, F. W., 294
Hauser, Ernst A., 616
Hawkins, James W., 619
Heard, O. O., 427
Hecht, Selig, 154
Hehre, Edward J., 523
Heil, John F., 376
Heller, H., 127
Hemming, Francis, 487, 584
Herzberg, G., 215
Hester, J. B., 595
Hinkle, M. E., 253
Hirsh, I. J., 333
Hixson, Ephriam, 422
Hodges, F. A., 425
Hoelzel, F., 616
Hofer, L. J. E., 470
Hoff, Donald A., 551
Hoffman, Joseph G., 343
Hoffpauir, Carroll L., 344
Hole, Francis D., 278
Holyoke, Edward A., 134
Holzheimer, William, 527
Hong, F. K., 291
Hopkins, E. F., 326
Horton, R. J. M., 415
Hoyt, Robert E., 171
Hrenoff, M. K., 64
Huber, L. L., 493
Huggins, Charles, 147
Hummer, George J., 169
Hutchins, Robert M., 195
Hutt, F. B., 379
Hwang, F. T., 291

I

Ingall, Fred, 376
Irons, W. G., 393
Irving, George W., Jr., 395
Isotopes Branch, U. S. Atomic Energy Commission, 175
Ivy, A. C., 455

J

Jackson, E. B., 418
Jackson, M. L., 19
Jarman, G. N., 355
Jeffrey, Edward C., 305
Jensen, C. O., 294
Johnston, C. O., 112
Johnston, Carter D., 91
Johnston, Francis E., 623
Jones, Ralph, Jr., 147
Joslyn, Dwight A., 417

K

Karczmar, Alexander G., 492
Karp, Mary, 249
Kehoe, Robert A., 63
Kelly, A. R., 298
Kent, Nancy, 547
Kesteven, G. L., 166
Kimura, T. E., 370
King, Robert W., 415
King, Theodore O., 492
Kinsell, Laurance W., 319, 589
Kirby, Harold, 462
Kirkwood, John G., 174
Knauss, Homer C., 265
Knight, J. Brookes, 315
Knisely, Melvin H., 431
Kohman, Edward F., 625
Kohman, Truman P., 62
Kollen, S., 471
Koppanyi, Theodore, 492
Kosolapoff, G. M., 22
Krasno, Louis, 249
Krebs, Ernst T., Jr., 151
Kuiper, G. P., 201
Kun, Ernest, 550
Kurzrok, Raphael, 430
Kushnick, T., 587

L

Lackey, Robert W., 618
Langham, Wright, 277
Langmuir, Irving, 241
Lansing, Albert I., 187
La Rue, Carl D., 145
Later, E. R., 368, 469
Lawrence, C. A., 525
Lawrence, John S., 473
Lawrence, Nancy, 104
Lazarus, Alfred S., 550
Leake, Chauncey D., 478
Lee, A. J., 349
Leikind, Morris C., 553
Lenz, Gilbert G.. 619
Levine, Joseph, 373
Levine, Milton Gjelhaug, 171
Lew, Gideon Ting-wei, 166
Lewey, F. H., 301
Lewis, Ivey F., 419
Lewis, Louis W., 451
Li, Min Hsin, 270
Libby, W. F., 88
Light, S. F., 131, 244
Lindsay, R. B., 303
Lingane, James J., 252
Little, J. Maxwell, 448
Littman, M. L., 109
Loeb, Leonard B., 229
Loewe, Leo, 494
Loewe, S., 89
Loftfield, Robert B., 544
Loofbourow, John R., 113
Loosanoff, V. L., 597
Loring, Hubert S., 104
Ludwick, N. Volney, 348
Lurie, H. I., 146
Lynch, T. E., 278

M

McCracken, Earl C, 453
McDaniel, W. B., II, 491
MacDougal, D. T., 316
McFarlane, W. D., 375
MacGinitie, G. E., 171
MacInnes, D. A., 241
McInroy, E. E., 317
McLain, Paul L., 275
MacLeod, Florence L., 67
Macy, R., 274, 355
Malisoff, William M., 591
Mandel, I. D., 132
Maren, T. H., 105
Marks, M., 349
Marrazzi, Amedeo S., 324, 520
Marrazzi, Rose N., 520
Marshak, A., 394
Marth, Paul C., 15
Martin, Gustav J., 168
Marton, L., 69
Martzloff, Karl H., 21
Mason, Lester, 646
Mather, Kenneth, 45
Mather, Kirtley F., 603
Mattson, A. M., 294
Meehan, Frances, 270
Meister, Alton, 167
Meister, Morris, 576
Mellen, W. P., 225
Meyerhoff, Howard A., 236
Michaels, George D., 589
Miles, W. R., 304, 377, 430
Miller, G. A., 333
Miller, R. C., 493
Miller, Robert C., 181
Miller, Warren W., 544
Milstone, J. H., 546
Mirsky, I. Arthur, 148
Mitchell, John W., 15, 226, 395
Moeller, Therald, 278
Monash, Samuel, 370
Montagna, William, 19
Moore, Carl R.. 622
Moore, George E., 130
Moore, Jared S., 84
Moreton, John R., 190
Morgan, W. W., 201
Morrison, A., 355
Moshkovski, Sh. D., 62
Moss, Jack, 168
Moulder, James W., 168
Moulton, F. R., 6, 310, 535
Muma, Martin H., 422
Murphy, H. C., 270
Murphy, Robert C., 618
Murray, Arthur, III, 277
Myers, Victor C., 454

N

Necheles, H., 368, 469
Neill, James M., 523
Nelsen, Olin E., 295
Neter, Erwin, 350
Nether, Raymond, 327
Neuda, Paul M., 296
Newcomer, Earl H., 601
Noback, Charles R., 19
Norton, Stata, 328
Nulsen, Frank E., 301
Nutting, P. G., 445

O

Odell, L. D., 265
Ogle, Ben C., 448
Olitsky, Peter K., 267
Olivier, L. J., 112
Oshry, E., 132
Otto, G. F., 105
Otvos, John W., 409

P

Page, Thornton, 227
Panzer, Basil I., 376
Payne, Merle G., 37
Pease, Daniel C., 543
Pegram, George B., 241
Peirce, E. Converse, 2nd, 619
Pelczar, Michael J., Jr., 524

Petty, Dorothy H., 344
Phillips, John W., 616
Phillips, Norman E., 67
Phillips, Ruth G., 616
Phleger, Fred B., Jr., 366, 460
Piatt, Jean, 502
Pillemer, Louis, 36
Pitt, Dorothy A., 420
Plank, Harold K., 317
Pogo, Alexander, 227
Pollard, Morris, 243
Popham, Richard A., 475
Potter, Alden A., 84
Potter, Van R., 252, 290, 342
Price, Vinçent E., 369
Proger, Samuel, 367

Q

Quick, Armand J., 591
Quigley, J. P., 595
Quimby, Freeman H., 67
Quirke, Terence T., 225

R

Raab, Walter, 546
Rabi, I. I., 241
Raiman, R. J., 368, 469
Randles, C. I., 587
Rankama, Kalervo, 13
Reed, C. I., 226
Reid, E. Emmet, 355
Reiner, John M., 354
Reynolds, S. R. M., 427
Rhoad, Albert O., 416
Rhodes, Paul S., 249
Richardson, Luther R., 644
Richter, Kenneth M., 598
Rick, Charles M., 645
Riesen, Austin H., 107
Robertson, H. P., 227
Robeson, F. L., 352
Rogers, J. W., 108
Rosenblith, Walter A., 22, 333
Ross, Jean A., 194
Ross, Oscar A., 36
Rossini, Frederick D., 377
Russell, Alfred, 372
Russell, Henry, 347
Russell, Jane A., 402
Ryder, Henry W., 63

S

Sabrosky, Curtis W., 315
Sano, Machteld E., 346
Sarason, Seymour B., 553
Saunders, George M., 300
Saxon, Paul A., 67
Schabel, F. M., Jr., 549
Schaffer, Norwood K., 347
Schallek, William, 421
Schloemer, Clarence L., 85
Schmidt, G., 367
Schubert, Jack, 403
Schulman, Martin P., 271
Schweigert, B. S., 522
Schwerdt, C. E., 104
Schwob, Claude R., 327
Scott, George T., 551
Scott, Virgil, 300
Seaman, Gerald R., 327
Sears, Paul B., 1
Seaton, S. L., 496
Seegers, Walter H., 41, 618
Segal, Leon, 132
Seidlin, S. M., 132
Sein, Francisco, Jr., 130
Seiwell, H. R., 76
Sellers, E. A., 108
Settlage, Paul, 300
Seymour, Allyn H., 245
Shaffer, Paul R., 454
Shafiroff, B. G. P., 474
Shao-Wen, Ling, 166
Shapley, Harlow, 411
Sheard, Charles, 169
Shelesnyak, M. C., 329, 405
Shelton, F. A., 595
Shenton, Walter F., 354
Sherwood, Marion B., 152
Shideman, F. E., 298
Silverman, Milton, 316
Sims, Ward L., 588
Sinason, H., 400
Sisler, Frederick D., 521
Slattery, M. C., 11
Smadel, J. E., 418
Smiley, Charles H., 228, 616
Smith, Hobart M., 11
Smith, J. A., 622
Smith, Karl U., 398
Smith, Mary Ruth, 86
Smith, Robert M., 417
Snyder, Laurence H., 347
Sognnaes, Reidar F., 447
Spark, Arthur H., 192
Specht, H., 551
Speck, Marvin L., 420
Spiegel, E. A., 349
Spiegel-Adolf, Mona, 346
Spratt, Nelson T., Jr., 452
Stahmann, Mark A., 35
Stanley, Alfred R., 551
Stanley, W. M., 241
Stauffer, J. F., 35
Steenken, W., Jr., 638
Steinhaus, Edward A., 323
Sterling, Clarence, 166
Stetson, Henry C., 460
Stewart, James M., 425
Stewart, John Q., 179
Stieglitz, Edward J., 92
Stier, T. J. B., 43
Strait, L. A., 64
Struik, D. J., 502
Struve, Otto, 149, 204, 217
Sturgeon, Phillip, 293
Subarsky, Zachariah, 127
Sutton, T. S., 92
Swanson, C. L. W., 256
Sward, Keith, 600
Sweet, Donald H., 617

T

Tatum, R. M., 97
Taylor, T. I., 498
Terzian, Levon A., 449
Thiessen, R., Jr., 317
Thimann, Kenneth V., 87
Thomas, G. J., 333
Thompson, James S., 47
Thornbury, William D., 174
Tislow, R., 345
Tolman, Leo, 168
Tolman, Richard C., 135
Topping, Norman H., 636
Trask, Parker D., 460
Traub, Hamilton P., 11
Truesdell, C. A., 623
Truhlar, Joseph, 371
Trytten, M. H., 3
Turner, Richard B., 248

U

Urey, Harold C., 241

V

Van Biesbroeck, G., 203
Van Cleave, Harley J., 194
Van Dusen, M. S., 428
Vennesland, Kirsten, 476
Visher, Stephen S., 359, 632
Vogt, William, 83
Voorhees, A. B., 68

W

Wagner, Charles D., 409
Wainio, W. W., 471
Walker, Burnham S., 347
Walton, Lucile, 419
Wang, Yu, 291
Ware, Arnold G., 41, 618
Ware, L. A., 490
Warner, Louise, 431
Washington Association of Scientists, Study Group, 385
Waterman, F. A., 499
Waters, Nelson F., 246
Watson, George F., 348
Weaver, Robert J., 268
Webster, Bethuel M., 444
Weesner, Frances M., 131, 244
Weida, Frank M., 303
Weimer, F. Carlin, 602
Weiss, Harry A., 589
Welander, Arthur D., 245
Welch, J. E., 594
Welker, William H., 554
Weller, Sol, 470
Went, F. W., 145
Wexler, H., 225
Wichterman, Ralph, 491
Wiersma, C. A. G., 421
Wildman, J. D., 425
Wilhelmi, Alfred E., 402
Williams, La Vergne E., 601
Winsten, Walter A., 192
Wiswell, O. B., 393
Wittenborn, J. R., 329
Wittwer, S. H., 590
Wolfe, W. C., 395
Wolfle, Dael, 529
Wolinsky, Emanuel, 638
Wood, John W., 395
Wood, W. Barry, Jr., 86
Wright, D. K., Jr., 624
Wrinch, Dorothy, 73
Wycis, H. T., 349
Wyss, Oscar A. M., 322

Y

Yeagley, John D., 448
Yoe, John H., 72
Yost, Don M., 303
Yü, Sung Ting, 147

Z

Zipkin, Isadore, 343
Zlotowski, Ignace, 308
ZoBell, Claude E., 521

Subject Index

A

- AAAS
  - Centennial Meeting, 535
  - Chicago Meeting, 99, 182, 555, 567, 613
  - Cooperative Committee on the Teaching of Science and Mathematics: Its Organization and Program, 28
  - Executive Committee, Statement on Otis W. Caldwell, 579
  - Financial Reports, 1945, 6
  - General Program, Production of, 612
  - George Westinghouse Science Writing Awards, 99, 513
  - Historical Sketch, 463
  - Inter-Society Committee for a National Science Foundation: Report for 1947, 529
  - Laurentian Hormone Conference, Roche-Organon Awards, 221, 389
  - Membership Dues, 310
  - Pacific Division Meeting, 181
  - Photography in Science, 99, 464
  - *Science*, Request for back issues, 285
  - Southwestern Division Meeting, 181
  - UNESCO Fellowships, 411
- Abstracting of Biological and Medical Sciences, UNESCO Initiates Cooperation in, 609
- Acetone, Use of, for Sterilizing Dry Proteins, Comment on, 127
- Ac-Globulin in Blood Clotting, Function of, 618
- Achievement Variables, Discovery of Aptitude and, 279
- Acid Phosphatase and Lipids in the Mast Cells of the Rat, 19
  - Reactions in Peripheral Nerves, 639
- Adenosinetriphosphatase Activity of Human Serum, 167
  - Enzymatic Hydrolysis of, Inhibition of, by Certain Cardiac Drugs, 370
- Aerosols, Penicillin, of High Concentration, 316
- Afterimage, Auditory, 333
  - Comment on, 617
- Agglutination Titer, Chicken Red Cell, Slide Rule for Determining, 273
- Aging and Cancer, Calcium and Growth in, 187
- Agricultural and Mechanical College of Texas, Department of Biochemistry and Nutrition, 59
- AF School of Aviation Medicine, Aeromedical museum, 541
- Air Pressure Effects, Oxygen and, Upon the Early Development of the Frog's Egg, 295
- *dl*-Alanine, Incorporation of C^{14} From Carboxyl-labeled, Into the Proteins of Liver Slices, 544
- Alimentary Hyperlipemia, Atherosclerosis and, 190
- Alloxan Diabetes, Oral Efficacy of BAL in Protecting Rats Against, 345
  - Diabetogenic Action of, Effect of Certain Substances on the Prevention of, 128
- Alpha Activity of Protactinium Samples, Routine Analysis of, 400
- American Allergy Fund, Grants-in-aid, 239
  - Chemical Society, Metropolitan Long Island Group of New York Section, 585
  - Museum of Natural History, Peruvian fossil collections, 144
  - Philosophical Society: Abstracts of Papers Presented at 1947 Annual General Meeting, 117; Autumn General Meeting, 628
  - Public Health Association, Public Health Biology Section, 586
  - Type Culture Collection, 365
- *American Men of Science*, Starring in, 359
  - Comment on, 617
- Amino Acids and Proteins, Analytical Determination of Basic Groups in, 277
- Ammonia Nitrogen Produced From Isomeric Peptides in Kidney Homogenate Digests, 369
- Ammonium Germicides, Quaternary, Rapid Method for Estimation of Use-Dilution Concentrations of, 525
- Anaphylactic and Histamine Shock, Effect of Rutin on, 368, 469
- Androgens, Identification and Chromatography of, as Their 2,4-Dinitrophenylhydrazones, 91
- Anemia, Acquired Hemolytic, New Antibody in Serum of Patients With, 293
- Animals, Small, Kinesimeter for Studying the Spontaneous Activity of, 499
- Antares (α Scorpii), 149
- Antibacterial Action of Inactivated Ergosterol in the Guinea Pig and Man, 546
- Antibiotic, Chloromycetin, a New, From a Soil Actinomycete, 417
  - Chloromycetin, With Chemotherapeutic Activity in Experimental Rickettsial and Viral Infections, 418
  - Citrinin as, 291
  - Compound Isolated From the Lichen *Ramalina reticulata*, 394
- Anticoagulant Found in Two Cases, Hemophilia: The Mechanism of Development and Action of, 473
- Antigens, Soluble Pertussal, Separation and Immunologic Evaluation of, 36
- Antimalarial Compounds in the Mosquito Host, Method for Screening, 449
- Aptitude and Achievement Variables, Discovery of, 279
- Archaeology, New Horizons in, 97
- Arginase, Elementary Effect of, in the Weight Physiology of the Mouse, 393
- Army Air Forces
  - Aptitude and Achievement Variables, Discovery of, 279
  - Civilian Skills in, Use of, 26
- Army Criminals, Incipient, Detection of, 93
- Arsenoxides, Substituted Phenyl, Filaricidal Activity of, 105
- Ascorbic Acid, Blood Plasma Ascorbic Acid Levels on Controlled Intakes of, 67
  - Oxidation of, to Dehydroascorbic Acid, 451
- Assay Procedures, Three- and Four-Dose, Simple Formulas for Calculating Percentage Potency in, 152
  - Cylinder-Plate, Sensitive, for Bacitracin, 551
- Astrometry, 203
- Astronomy, Department of, of the University of Chicago, 195
- Astrophysics, Theoretical, Solar Research and, 213
- Atabrine and Cyanine 348, 316
- Atherosclerosis and Alimentary Hyperlipemia, 190
- Atmosphere, Exchange of Carbon Dioxide Between Barium Carbonate and, 403
- Atomic Bombs, Genetic Effects of, in Hiroshima and Nagasaki, 331
- Atomic Energy Commission
  - Advisory Committee for Biology and Medicine, 285
  - Board of Consultants for Industrial Development, 489
  - Brookhaven National Laboratory, First peacetime atomic pile, 162
  - Clinton National Laboratory, 365
  - Fifth anniversary of first self-sustained chain-reacting pile, 542
  - Isotope Distribution Program, 175
  - Office of Public and Technical Information, 414

  Radioactive isotope distribution abroad, 240
  Scientific Personnel Committee, 224
Auditory Afterimage, 333
  Comment on, 617
  Equivalents, Conversion of Heart Potentials Into, 151
Avian Pneumoencephalitis (Newcastle Disease) Virus, Isolation of, From the Yolk Sac of Four-Day-Old Chicks, Embryos, and Infertile Eggs, 545

B

Bacillus subtilis, Variants of *Escherichia coli*, *Pseudomonas aeruginosa*, and, Requiring Streptomycin, 587
Bacitracin, Sensitive Cylinder-Plate Assay for, 551
Bacteria, Relationship Between Cystine and Pyridoxal or Pyridoxamine in the Nutrition of Certain, 420
Bacteriostasis and the Problem of Contact, 241
Bacteroides, *In Vitro* Resistance of the Genus, to Streptomycin, 423
BAL, Dithiopropanol, Influence of, on Human Lead Metabolism, 63
  Oral Efficacy of, in Protecting Rats Against Alloxan Diabetes, 345
  Subtilin and Streptomycin in the Presence of, Antibiotic Activity of, 643
Bamboo, DDT for Powder-Post Beetle Control in, 317
Barium Carbonate, Exchange of Carbon Dioxide Between, and the Atmosphere, 403
Bean and Oat Plants Containing Known Amounts of a Labeled Plant-Growth Regulator (2-Iodo^{131}-3-Nitrobenzoic Acid), Relative Growth Rates of, 395
Beetle, Powder-Post, Control in Bamboo, DDT for, 317
Benzene Hexachloride, Effect of, on the Flavor of Poultry Meat, 422
Bioassay by Direct Potency Estimation, 89
Biochemical Reaction, Use of Isotopes to Determine the Rate of, 404
Biology, National Institute of, Relation of Teachers in Secondary Schools to, 127
  Of Cancer, 455
Biosynthesis of Penicillins, 503
Blood Cells, Red, Fluorescence of, 169
  Coagulation, Prothrombokinase and the Three Stages of, 546
  Calcium in, Is the Action Stoichiometric or Catalytic?, 591
  Clotting, Function of Ac-globulin in, 618
  -Group-Enzyme, Red Blood Sensitivity to, 296
  Levels, Penicillin, Enhancement of, Following Oral Administration of Caronamide, 494
   Use of Insoluble Penicillin Salts for the Prolongation of, 370
  Plasma Ascorbic Acid Levels on Controlled Intakes of Ascorbic Acid, 67
  Sludged, 431
  Types, M-N, Linkage Between the Genes for Sickle Cells and, 347
  Whole, Electrical Resistance of, 68
Books (see Reviews; Scientific Book Register)
Brain, Human, Stereotaxic Apparatus for Operations on, 349
  Macroscopic Sectioning of, Simple Device for, 527
British Association for the Advancement of Science, Resolution on restriction of freedom of publication, 289
Bufo cognatus and *Bufo compactilis*, Tadpoles of, 166
"Bumping" From Superheating of Boiling Fluids, Polytetrafluoroethylene for the Prevention of, 646
Bunchy Top Disease of Papaya (*Carica papaya* L.), Transmission of, by the Leaf Hopper *Empoasca papayae* Oman, 130

C

Cage Designs, Improved, for Use in Handling Monkeys, 18
Calcium and Growth in Aging and Cancer, 187
  In Cancer, Role of, 490
  In the Coagulation of Blood, Is the Action Stoichiometric or Catalytic?, 591
Calculator, Simple, for Certain Types of Instrumental Data, 595
Cancer, Aging and, Calcium and Growth in, 187
  Biology of, 455
  Calcium in, Role of, 490
  Prostatic, Inhibitory Effects of Ethyl Carbamate on, 147
  Research, Application of "Metabolite Antagonism" to, 271
   Congress, Fourth International: St. Louis, September 2–7, 1947, 479
  Roscoe B. Jackson Memorial Laboratory, 411
C^{14}, Incorporation of, From Carboxyl-labeled *dl*-Alanine Into the Proteins of Liver Slices, 544
Carbon Dioxide, Exchange of, Between Barium Carbonate and the Atmosphere, 403
  Isotopically Enriched, Conversion of, to CO, 498
Carboxyl-labeled *dl*-Alanine, Incorporation of C^{14} From, Into the Proteins of Liver Slices, 544
Carcinogenic Hydrocarbons, Microbial Utilization of, 521
Cardiac Drugs, Certain, Inhibition of the Enzymatic Hydrolysis of ATP by, 370
Caronamide, Enhancement of Penicillin Blood Levels Following Oral Administration of, 494
  Staticin, 264
Carotene Content of Corn, Influence of Heredity on, 493
  β-, Oxidation of, With Osmium Tetroxide, 375
Carrot, Male Sterility in, 594
Case Institute of Technology, Betatron project, 485
  Research Laboratory for Mechanical Metallurgy, 288
Castes in Higher Termites, Development of, 244
Catheter, Ureteral, for Microinjection Tubing, 551
Cattle, Heat Tolerance Formulas for, 416
Celery, Chemical Control of Seedstalk Development in, 590
Cell Biology, Society for, Membership in, 540
  Lineages, Certain Plant, Irreversible Differentiation in, 320
Cellulose and Its Uses, 290
  Misuse of, in the Design of Experimental Diets, 616
Centrarchids, Texas, Reproductive Cycles of Five Species of, 85
Centrifuge Operations, Duration and Speed of, A Correction, 265
Cerebrospinal Fluid, Effect of the Injection of Glucose Into, 618
  Ultraviolet Absorption Spectrum of: Ascorbic Versus Nucleic Acid, 64
Chemical Components of Onion Vapors Responsible for Wound-healing Qualities, 625
  Structure and the Definition of Sympathin E, 520
  Substances, Direct Introduction of, Into Herbaceous Plants, 251
Chemotherapeutic Activity in Experimental Rickettsial and Viral Infections, Chloromycetin, An Antiobiotic With, 418
Chick Embryo, Phosphorus Metabolism in, The Effects of Vitamins on: Vitamin D and the Utilization of Inorganic Phosphorus, 637
  Embryos, Early, Explanting and Cultivation *in Vitro*, Simple Method for, 452

  Inoculating, Simplified Techniques for, and a Means of Avoiding Egg White in Vaccines, 324
Chicken Red Cell Agglutination Titer, Slide Rule for Determining, 273
Chickens, Contagious Nature of a Lymphoid Tumor in, 246
Chicks, Embryos, and Infertile Eggs, Isolation of Avian Pneumoencephalitis (Newcastle Disease) Virus From the Yolk Sac of Four-Day-Old, 545
China, National Academy of, 224
Chinese National Fisheries Research Institute, 166
  Scientific societies, Resolutions on atomic energy and scientific research, 517
Chloride, Triphenyltetrazolium, as a Dye for Vital Tissues, 294
Chloromycetin, a New Antibiotic From a Soil Actinomycete, 417
  Antibiotic With Chemotherapeutic Activity in Experimental Rickettsial and Viral Infections, 418
Chromatography, Identification and, of Androgens as Their 2, 4-Dinitrophenylhydrazones, 91
Citric Acid in Saliva, 343
Citrinin as an Antibiotic, 291
Civilian Skills in the Army Air Forces, Use of, 26
Clostridium botulinum, Effect of Flavonols on, 644
Clotting, Blood, Function of Ac-Globulin in, 618
Cobalt and Nickel, Freezing Points of, and a New Determination of Planck's Constant C_2, 428
Cold, Common, Experimental Studies With the Agent of, 243
  Note Regarding Isolation of an Agent, 636
  Waves, Hard, Differential Rate of Death for Large and Small Fishes Caused by, 472
Color Reactions of Sulfonamides with β-Naphthoquinone-4-Sulfonate, 426
Columbium, On the Geochemistry of, 13
Complement Fixation Tests, Elimination of the False Positive Reaction With Human Sera in, 43
Condon, E. U., Attack on, by J. Parnell Thomas, 241
Cone Gall of Witch Hazel, Initiation of, 419
Containers, Small, Method for Permanent Identification of Materials Sealed in, 550
Copper, Nutritional Disease of Oats Apparently Due to the Lack of, 398
Coproantibody Excretion During Enteric Infections, 188
Corn, Influence of Heredity on the Carotene Content of, 493
Cornell University, Program in metallurgical engineering, 515
  Savage Hall dedication, 288, 466
Cosmic Radiocarbon and Natural Radioactivity of Living Matter, 88
Cotton Seeds, Individual, Germination and Free Fatty Acid in, 344
Creatinine, Total, Creatinuria in Diabetics and an Evaluation of Methods for Determining, 371
Creatinuria in Diabetics and an Evaluation of Methods for Determining Total Creatinine, 371
Criminals, Incipient Army, Detection of, 93
Cross-indexing a Reference File, Simple Method for, 109
Crystalline Pituitary Protein With High Growth Activity, 402
Cultivating Early Chick Embryos *in Vitro*, Simple Method for Explanting and, 452
Culture Medium for *Hemophilus influenzae:* Yeast Autolysate, 350
  For the Primary Isolation of Fungi, 109
  Method, Contact, for Detecting Molds on Surfaces, 425
  Tube, New Rectal, 275
Cultures, Protozoan, Penicillin as an Agent for Sterilization of, 327
Cutworm, Variegated, *Peridroma margaritosa* (Haw.), New Disease of, 323
Cylinder-Plate Assay, Sensitive, for Bacitracin, 551
Cystine and Pyridoxal or Pyridoxamine in the Nutrition of Certain Bacteria, Relationship Between, 429
Cytochrome C, 367
  In Therapy, 342
  Oxidase, 471

D

DDT for Powder-Post Beetle Control in Bamboo, 317
Death, Differential Rate of, for Large and Small Fishes Caused by Hard Cold Waves, 472
Deformation, Thermodynamics of, 445
Dehydroascorbic Acid, Oxidation of Ascorbic Acid to, 451
Dental Aspects of Prenatal Injury, 415
  Caries, Possible Role of Food Purification in the Etiology of, 447
Dermatological Material, Mounting of, With Synthetic Resins, 646
Detection of Incipient Army Criminals, 93
Diabetes, Alloxan, Oral Efficacy of BAL in Protecting Rats Against, 345
  Malnourishment and, in Bengal Indians, 290
  Mellitus, Hexokinase Activity and, 148
Diabetics, Creatinuria in, and an Evaluation of Methods for Determining Total Creatinine, 371
Diabetogenic Action of Alloxan, Effect of Certain Substances on the Prevention of, 128
2,4-D and Related Compounds, Some Effects of Ultraviolet Light on, 37
  Relative Sensitivity of Dormant and Germinating Seeds to, 266
  Weed Killers, Use of, on Woody Weeds in Cuba, 87
Differentiation, Irreversible, in Certain Plant Cell Lineages, 320
2,4-Dinitrophenylhydrazones, Identification and Chromatography of Androgens as Their, 91
Diphtheria Bacilli, Production of Starch-like Material From Glucose-1-phosphate by, 523
Discharge Through Gases, 229
Disease, One Unconsidered Form of the Part Played by the Nervous System in the Development of, 242
Dithiopropanol (BAL), Influence of, on Human Lead Metabolism, 63
Dithymol Diiodide, Physiological Availability of Iodine in, 317
DNPH (see 2,4-Dinitrophenylhydrazones)
Dogwoods, White, Pink Flowers on, 145
Drainage, Acid Mine, Role of Microorganisms in, 253
Drosophila, Note on the Theory of Radiation-induced Lethals in, 87
Dryer, Hot-Air Apparatus, for General Laboratory Use, 353
Dye for Vital Tissues, Triphenyltetrazolium Chloride as, 294

E

Earlham College Centennial, 311
Earth's Crust, Abundance of Thallium in, 268
Ecology, Human, in Polar Regions, Some Problems of, 405
  In the Training of Engineers, Importance of, 1
ED_{50} Curves, Instrument for Plotting, 151
Editing of Scientific Papers, 289, 491
Educational Programs at Research Centers, 283
Eggs, Activation of, by Oxidation-Reduction Indicators, 320
  Volume of, in the Oyster Gonad, 342
Electrical Resistance of Whole Blood, 68

Electrode Assembly, Concentric Glass, for pH Measurements, 597
Electromagnetic Sphygmograph, Improved, 376
Electron Microscopy, Disappearance of Salt From Glass Ice During Low-Temperature Dehydration, and Its Implication in, 543
Embedding in Paraffin, Importance of Controlling Cooling Temperatures During, 475
Embryo Extract, Mincing Apparatus for the Preparation of, for Tissue Culture, 621
Embryos, Growth *in Vitro* of Immature *Hordeum*, 547
Employment, Shift of, Among Younger Scientists, 3
Endotoxin of *Trypanosoma cruzi* (KR), Action of, on Malignant Mouse Tumors, 591
Engineers, Importance of Ecology in the Training of, 1
Enteric Infections, Coproantibody Excretion During, 188
Enzymatic Hydrolysis of ATP, Inhibition of, by Certain Cardiac Drugs, 370
Enzyme, Blood-Group-, Red Blood Cell Sensitivity to, 296
Ergosterol, Inactivated, Antibacterial Action of, in the Guinea Pig and Man, 546
Escherichia coli, *Pseudomonas aeruginosa*, and *Bacillus subtilis*, Variants of, Requiring Streptomycin, 587
Ethyl Carbamate, Inhibitory Effects of, on Prostatic Cancer, 147
Europe, Technical Book Publishing in, 1947: Impressions From Visits to Eleven Countries, 47
  Continental, Scientific Publishing in: Notes on Its War and Postwar Status, 54
Explanting and Cultivating Early Chick Embryos *in Vitro*, Simple Method for, 452
Eye Laboratory, St. Vincent's Hospital, Los Angeles, 414

F

F_1 Layer Ionization, Geomagnetic Control of, 17
False Positive Reaction, Elimination of, With Human Sera in Complement Fixation Tests, 43
Fat, Protein, and Glucose, Homogeneous Emulsion of, for Intravenous Administration, 474
Fatty Acid, Free, Germination and, in Individual Cotton Seeds, 344
Fecal Smears, Use of Polyvinyl Alcohol to Preserve, for Subsequent Staining, 42
Fecundity of the Oyster, 290
Federation of American Scientists, Admission of members-at-large, 469
Feulgen's Nucleal Reaction, Staining of Nerve Endings in Mouse Epidermis by, 70
Filaricidal Activity of Substitute Phenyl Arsenoxides, 105
Fisheries Research Institute, Chinese National, 166
Fishes, Large and Small, Differential Rate of Death for, Caused by Hard Cold Waves, 472
Flame Photometer, Improving the Performance of, 551
Flavonols, Effect of, on *Clostridium botulinum*, 644
Flavor of Poultry Meat, Effect of Benzene Hexachloride on, 422
Flower Marker for Plant-breeding Operations, 645
Fluid, Simple Quantitative Method for Intravenous Injection of Small Volumes of, 401
Fluorescein as an Agent in the Differentiation of Normal and Malignant Tissues, 130
Fluorescence of Red Blood Cells, 169
Fluorinated and Fluorine-free Communal Waters, Artificially, *Lactobacillus acidophilus* Counts in the Saliva of Children Drinking, 292
Folic Acid, 7-Methyl, Mode of Action of, 168
Folliculinids in India, 145
Food and Container Institute, Associates of, 165
  Purification, Possible Role of, in the Etiology of Dental Caries, 447
Formaldehyde in Plant Collecting, 250
  Inactivated Poliomyelitis Virus, Preparation of, and Its Use as an Immunizing Agent in Cotton Rats, 104
Fowl, Genetic Control of Lymphomatosis in, 379
Frog's Egg, Oxygen and Air Pressure Effects Upon the Early Development of, 295
Fulbright Act, Board of Foreign Scholarships, 78
Fungi That Cause Decay of Heartwood Are Pathogens, 62
  Primary Isolation of, Culture Medium for, 109
Funnel Design, Improved, 132
β-D-Furanofructosidase Activities of the Invertases From Top and Bottom Yeast on Levulins, 11

G

Ganglionic Activity, Sympathetic, Effect of Tetraethyl Pyrophosphate on, 492
Gases, Discharge Through, 229
Gauge, Rain and Snow, All-Weather Noncorrosive, Sulfur Collection in Precipitation by Means of, 19
Genes for Sickle Cells, Linkage Between, and the M-N Blood Types, 347
Genetic Control of Lymphomatosis in the Fowl, 379
  Effects of the Atomic Bombs in Hiroshima and Nagasaki, 331
Geochemistry of Columbium, 13
Geomagnetic Control of F_1 Layer Ionization, 17
Germicides, Quaternary Ammonium, Rapid Method for Estimation of Use-Dilution Concentrations of, 525
Germination and Free Fatty Acid in Individual Cotton Seeds, 344
Gerontology, National Advisory Council for Research in, 392
Glass Electrode Assembly for pH Measurements, Concentric, 597
  Ice, Disappearance of Salt From, During Low-Temperature Dehydration, and Its Implication in Electron Microscopy, 543
Glucose, Fat, and Protein, Homogeneous Emulsion of, for Intravenous Administration, 474
  Injection of, Into the Cerebrospinal Fluid, Effect of, 618
Glucose-1-phosphate, Production of Starch-like Material From, by Diphtheria Bacilli, 523
β-Glucuronidase Activity of Normal, Tumor, and Lymph Node Tissues of Surgical Patients, Comparison of, 66
Glutathione, Penicillin and, 146
Gonad, Oyster, Volume of Eggs in, 342
Gonadotropic Potency of Dried Anterior Pituitaries of *Rana pipiens*, Seasonal Variation in, 588
Government-sponsored Research, Operational Analysis in Relation to Administration of, 113
Granulosa Cell Tumors in Intrapancreatic Ovarian Grafts in Castrated Mice, 270
Graphs, Three-dimensional, 326
Grasses and Some Crop Plants, Sensitivity of, to Isopropyl-N-Phenyl Carbamate, 15
Growth Hormone Determination in Subtropical Plants, 316
  Promotion and Inhibition of, 265
  Rates, Relative, of Bean and Oat Plants Containing Known Amounts of a Labeled Plant-Growth Regulator (2-Iodo^{131}-3-Nitrobenzoic Acid), 395

- Gymnosperm Lignin, The Synthesis of: Interpretation of Lignin, 372
- Gyrofrequency, Experimental Determination of, 496

H

- Halogen-Metal Interconversion Reaction and Its Application to the Synthesis of Nicotinic Acid Labeled With Isotopic Carbon, 277
- Harvard University, Faculty Committee on Calculator, 486
- Heart Beat Studies, Use of an Electric Drill-operated Trephine in Preparing Turtles for, 622
  - Potentials, Conversion of, Into Auditory Equivalents, 151
- Heart-Water Fever, Agent and Name of, 62
- Heartwood, Fungi That Cause Decay of, Are Pathogens, 62
- Heat Tolerance Formulas for Cattle, 416
- Helen Hay Whitney Foundation, Formation of, 165
- *Helminthosporium victoriae*, Differential Phytotoxicity of Metabolic By-Products of, 270
- Hematocrit Methods, Comparison of, 275
- Hemolytic Anemia, Acquired, New Antibody in Serum of Patients With, 293
- Hemophilia: The Mechanism of Development and Action of an Anticoagulant Found in Two Cases, 473
- *Hemophilus influenzae*, Yeast Autolysate: Culture Medium for, 350
- Herbaceous Plants, Direct Introduction of Chemical Substances Into, 251
- Herbarium Material, Use of Trisodium Phosphate With, and Microfossils in Peat, 325
- Heredity and Sex, The Nucleus in Relation to, 305
  - Influence of, on the Carotene Content of Corn, 493
- Hexokinase Activity and Diabetes Mellitus, 148
- Hiroshima and Nagasaki, Genetic Effects of the Atomic Bombs in, 331
- Histamine Shock, Effect of Rutin on Anaphylactic and, 368, 469
- *Hordeum* Embryos, Immature, Growth *in Vitro*, 547
- Hot-Air Apparatus Dryer for General Laboratory Use, 353
- Human Ecology in Polar Regions, Some Problems of, 405
- Humans, Plasma L-Methionine Levels Following Intravenous Administration in, 319
- Humidity and Tolerance to Low Barometric Pressure, 67
- Hutton, James, 150th anniversary of death, 488
- Hydra, Use of, for Pharmacological Study, 328
- Hydrocarbons, Carcinogenic, Microbial Utilization of, 521
  - Petroleum-like, Natural Formation of, From "Oil Shales," 41
- Hydrocephalus in Infant Rast, Inadequate Maternal Nutrition and, 644
- Ortho-Hydroxyphenylacetic Acid From an Amorphous Penicillin, 373
- Hyperlipemia, Alimentary, Atherosclerosis and, 190

I

- Identification, Permanent, of Materials Sealed in Small Containers, Method for, 550
- Illinois Institute of Technology, Technology Center, 581
  - State Geological Survey Program, 541
- India, Folliculinids in, 145
- Indian Phytopathological Society, Membership in, 61
- Indiana University, New Department of Bacteriology, 363
- Indole, Effect of, on the Determination of *N'-Methylnicotinamide*, 622
- Influenza Virus Strain Study Center, 542
- Inhalation of Penicillin Dust, 249
- Inhibitors in Soybean, Role of, 421
- Inhibitory Effects of Ethyl Carbamate on Prostatic Cancer, 147
- Injection, Intravenous, of Small Volumes of Fluid, Simple Quantitative Method for, 401
- Institute for Advanced Study, School of Mathematics, Stipends offered, 336
- Institutum Divi Thomae, Clinical Advisory Committee, 515
- Instrumental Data, Simple Calculator for Certain Types of, 595
- Inter-American Institute of Agricultural Sciences, 260
- Intercellular Surface Phagocytosis, 86
- Intermountain Plant Pathologists, Organization of, 365
- International Astronomical Union, Asteroid center at University of Cincinnati, 222
  - Biometric Society, Formation of, 413
  - Congresses
    - Biometric, Organizing Committee, 125; Conference, 413
    - Cancer Research, 1947, 479
    - Crystallographic Union, 1948, 288
    - Entomology, Stockholm, 1948, 60
    - Exclusion of Germans From, 12
    - Geographical Union, Lisbon, 1948, 164
    - Mental Hygiene, London, 1948, 263
    - Physiological Congress, 1947, Travel fellowships, 486
    - Poliomyelitis, 1948, 634
    - Poultry, Copenhagen, 1948, 164
    - Rheological, 1948, 634
    - Tropical Medicine and Malaria, Washington, D. C., 1948, 223
    - Zoology, Paris, 1948, 60, 101
  - Mathematics Union, Proposal for, 126
  - Union of Biological Sciences, IXth General Assembly, 364
- Intestinal Perfusion in the Treatment of Uremia, 108
- Intraneural Bipolar Stimulation: A New Aid in the Assessment of Nerve Injuries, 301
- Intravenous Administration, Homogeneous Emulsion of Fat, Protein, and Glucose for, 474
  - Injection of Small Volumes of Fluid, Simple Quantitative Method for, 401
- Inulin Clearance, Relation of, to Rate of Urine Flow in Rats, 127, 341
- Invertases From Top and Bottom Yeast, β-D-Furanofructosidase Activities of, on Levulins, 11
- Iodine, Physiological Availability of, in *Dithymol Diiodide*, 317
  - Radioactive, as a Tracer in the Study of the Physiology of Teeth, Use of, 132
    - Interlaboratory Comparison of Measurements of, 302
- Ion Exchangers, Reaction of Certain Plant Growth Regulators With, 268
- Ionization, F_2 Layer, Geomagnetic Control of, 17
- Iowa State College, Course in agricultural climatology, 389
  - Institute for Atomic Research, 163
  - New food-processing laboratory, 515
- Iron Compounds in Red and Yellow Sandstone, Nature of, 470
  - Solubility of, in Submerged Soils, 595
- Iroquois Research, Third Conference on, 539
- Isomeric Peptides in Kidney Homogenate Digests, Ammonia Nitrogen Produced From, 369
- Isopropyl-N-Phenyl Carbamate, Sensitivity of Grasses and Some Crop Plants to, 15
- Isotopes, Use of, to Determine the Rate of a Biochemical Reaction, 404
- Isotopic Carbon, Halogen-Metal Interconversion Reaction and Its Application to the Synthesis of Nicotinic Acid Labeled With, 277
  - Compounds, System of Nomenclature for, 409

- Isotopically Enriched CO_2, Conversion of, to CO, 498
- Istituto Italiano di Idrobiologia, Foreign guests, 314

J

- James F. Lincoln Arc Welding Foundation, Engineering Undergraduate Award and Scholarship Program, 465
- Japan, Reconnaissance Soil Survey Work in, 256
- John and Mary R. Markle Foundation, Post-fellowship grants, 441
- Journals
  - *Acta Chemica Scandinavica*, 264
  - American Institute of Physics, Unnamed, 392
  - *American Statistician*, 488
  - *Analytica Chimica Acta*, 126
  - *Applied Mechanics Reviews*, 541
  - *Applied Scientific Research*, 165
  - *Biochimica et Biophysica Acta*, 126
  - British Medical Association publications, 585
  - *Directory of Commercial and College Laboratories*, 542
  - *Evolution*, 314
  - *Excerpta Medica*, 144
  - *German Hydrographic Journal*, 126
  - *Heredity*, 165
  - *La Cellule*, 166
  - *Nucleonics*, 144
  - *Psychosomatic Medicine*, 82
  - *Research*, 585
  - *Scientific American*, 469
  - *South African Science*, 392
  - *Spectrochimica Acta*, 186
  - *Washington Report on the Medical Sciences*, 440

K

- Kidney Homogenate Digests, Ammonia Nitrogen Produced From Isomeric Peptides in, 369
- Kinesimeter for Studying the Spontaneous Activity of Small Animals, 499
- Kymograph Records, Solution for Plasticizing, 350
  - Tracings, Simple Pen for, 451

L

- *Lactobacillus acidophilus* Counts in the Saliva of Children Drinking Artificially Fluorinated and Fluorine-free Communal Waters, 292
- "Langley," Definition and Abbreviation of, 225
- Languages and Scientific Education, 490
- Larvae, Oyster, Staining of, as a Method for Studies of Their Movements and Distribution, 597
- Lead Metabolism, Human, Influence of Dithiopropanol (BAL) on, 63
- Leptospirosis in Micronesia, Further Observations on, 294
- Lethals, Radiation-induced, in *Drosophila*, Note on the Theory of, 87
- Levinstein Process Mustard Gas, Polysulfides in, 355
- Levulins, β-D-Furanofructosidase Activities of Invertases From Top and Bottom Yeast on, 11
- Lichen *Ramalina reticulata*, Antibiotic Compound Isolated From, 394
- Life Insurance Medical Research Fund, Grants-in-aid and fellowships, 467
- Lignin, Interpretation of: The Synthesis of Gymnosperm Lignin, 372
- Limb Duplication, Polydactyly and, Occurring Naturally in the Tiger Salamander, *Ambystoma tigrinum*, 641
- Lipids, Acid Phosphatase and, in the Mast Cells of the Rat, 19
  - Serum, Inactivation of Certain Neurotropic Viruses *in Vitro* by, 267
- Liver Damage, Rate of Disappearance From Plasma of Intravenously Administered Methionine in Patients With, 589
  - Slices, Incorporation of C^{14} From Carboxyl-labeled *dl*-Alanine Into the Proteins of, 544
- Loggerhead Turtles, Migration of Newly-hatched, Toward the Sea, 398
- Long Island College of Medicine, Psychiatry program, 338
- Lymph Node, Normal, and Tumor Tissues of Surgical Patients, Comparison of the β-Glucuronidase Activity of, 66
- Lymphoid Tumor in Chickens, Contagious Nature of, 246
- Lymphomatosis in the Fowl, Genetic Control of, 379

M

- Macroscopic Sectioning of the Brain, Simple Device for, 527
- Male Sterility in the Carrot, 594
- Malnourishment and Diabetes in Bengal Indians, 290
- Marine Laboratories, Sea Water Systems at, 171
  - Microplankton Organisms, Lethal Effect of X-Rays on, 245
- Massachusetts Institute of Technology, Course in the Colloid Chemistry of Silicon, 287
- Mast Cells of the Rat, Acid Phosphatase and Lipids in, 19
- Medulla Oblongata, Separate Localization in, of the Vagal Inspiratory and Expiratory Reflex Centers, 322
- Meetings, 1948
  - American Academy of Oral Pathology, 583
    - Association of Petroleum Geologists, 60
    - College of Physicians, 101
    - Dairy Science Association, 516
    - Institute of Chemists, 634
    - Physical Society, 516
  - Conference on Protein Metabolism, 486
    - Soil Scientists, Puerto Rico, 313
  - Faraday Society Conference on Physical Chemistry of Process Metallurgy, 486
  - Midwest Power Conference, 516
- Metabolism, Oxidative, of *Trypanosoma lewisi*, Effect of Age of Infection Upon, 168
- "Metabolite Antagonism," Application of, to Cancer Research, 271
- Methionine, Intravenously Administered, in Patients With Liver Damage, Rate of Disappearance From Plasma of, 589
- L-Methionine Levels, Plasma, Following Intravenous Administration in Humans, 319
- Methyl-bis(β-chloroethyl)amine, Induction of Mutants in *Penicillium notatum*, by, 35
- 7-Methyl Folic Acid, Mode of Action of, 168
- N′-Methylnicotinamide, Effect of Indole on the Determination of, 522
- Mexico, Gulf of, Recent Changes in Sedimentation in, 400
- Mice, Castrated, Granulosa Cell Tumors in Intrapancreatic Ovarian Grafts in, 270
- *Microbacterium lacticum* Orla-Jensen, Vitamin Requirements of, 524
- Microbial Utilization of Carcinogenic Hydrocarbons, 521
- Micrography, Tracer, 69
- Microinjection Tubing, Ureteral Catheter for, 551
- Micronesia, Further Observations on Leptospirosis in, 294
- Microorganisms, Role of, in Acid Mine Drainage, 253
- Micro-Pipette Trimmer, Precision, 598
- Microscope Slides, Use of Phenol Formaldehyde and Vinyl Resins in Sealing Liquid Mounting Media on, 299
- Microscopical Technic, Use of Trisodium Phosphate in, 194
- Migration of Newly-hatched Loggerhead Turtles Toward the Sea, 398
- Military Psychology in War and Peace, 155

Mincing Apparatus for the Preparation of Embryo Extract for Tissue Culture, 621
Mine Drainage, Acid, Role of Microorganisms in, 253
Mitotic Index, Wright's Hypothesis: Its Relation to Volume Growth of Tissue Cells and, 343
Molds on Surfaces, Contact Culture Method for Detecting, 425
Monitoring Probe for Radiochemistry Laboratories, 327
Monkeys, Effective and Nontraumatic Method of Handling, 300
  Improved Cage Designs for Use in Handling, 18
Monocytes in the Spleen, Origin of, 346
Morphine, Adaptation of the Silicomolybdic Acid Method for the Estimation of, to the Photoelectric Colorimeter, 298
Mosquito Host, Method for Screening Antimalarial Compounds in, 449
Mounting of Dermatological Material With Synthetic Resins, 646
Mouse, Elementary Effect of Arginase in the Weight Physiology of, 393
Mustard Gas, Laboratory Preparation of, 374
  Levinstein Process, Polysulfides in, 355
Mutants, Induction of, in *Penicillium notatum* by Methyl-bis(β-chloroethyl)-amine, 35

N

β-Naphthoquinone-4-Sulfonate, Color Reactions of Sulfonamides With, 426
National Academy of Sciences: Abstracts of Papers Presented at 1947 Autumn Meeting, 505
National Bureau of Standards, Division of Building Technology, 264
  National Applied Mathematics Laboratories, 519
  "Tables of Selected Values of Chemical Thermodynamic Properties," 225
National Research Council
  Building Research Advisory Board, 487
  Committee on Applied Mathematical Statistics, Report of, 391
    Aviation Psychology, 517
    Drug Addiction and Narcotics, 487
    Growth, 9, 223
    Survey of Food and Nutrition Research, 223
    UNESCO, 61
  Fellowships in cancer research, 9, 223
    Medical Sciences, 583
    Merck, 468
    Natural Sciences, 540
  Medical Advisory Committees, 185
  Office of Scientific Personnel, 3
  RCA Fellowship Board, 263
National Science Foundation, 58, 78, 141, 236, 237, 340, 385, 415, 444
  Inter-Society Committee for: Report, 529
Native Protein, 73
Nerve Endings in Mouse Epidermis, Staining of, by Feulgen's Nucleal Reaction, 70
  Injuries, Intraneural Bipolar Stimulation: A New Aid in the Assessment of, 301
Nerves, Peripheral, "Acid Phosphatase" Reactions in, 639
Nervous System in the Development of Disease, One Unconsidered Form of the Part Played by, 242
Netherlands East Indies, Status of Scientific Institutions in, 145
Neurotropic Viruses, Certain, Inactivation of, *in Vitro* by Serum Lipids, 267
Newcastle Disease, Avian Pneumoencephalitis, Virus, Isolation of, From the Yolk Sac of Four-Day-Old Chicks, Embryos, and Infertile Eggs, 545
Newton, Sir Isaac, Correspondence of, 102
New York Academy of Sciences, Publication of *The biology of melanomas*, 312
  University, Fluid dynamics program, 59
  Zoological Society, Studies of melanomas, 337
Nickel and Cobalt, Freezing Points of, and a New Determination of Planck's Constant C_2, 428
Nicotine, Protection of Synaptic Transmission Against Block by, 421
Nicotinic Acid Labeled With Isotopic Carbon, Halogen-Metal Interconversion Reaction and Its Application to the Synthesis of, 277
Nitrogen, Ammonia, Produced From Isomeric Peptides in Kidney Homogenate Digests, 369
Nomenclature for Isotopic Compounds, System of, 409
  Zoological
    Cowdria ruminantium, 62
    Errors and Emendations of, 315
    International Commission on, Applications for suspension of *Règles Internationales*, 487, 584
    Occupancy, Availability, and Validity, 11
    Paramecium multimicronucleatum versus *Paramecium nucleatum*, 491
  Vitamin, 226
Northwestern University, Agreement with Spies Committee, 337
  Technological Institute, Laboratory for teaching of catalytic and high-pressure processes, 581
Nucleus in Relation to Heredity and Sex, 305
Nuclide, Proposed Use of, 62
Nutrition, Inadequate Maternal, and Hydrocephalus in Infant Rats, 644
Nutritional Disease of Oats Apparently Due to the Lack of Copper, 398

O

Oat and Bean Plants Containing Known Amounts of a Labeled Plant-Growth Regulator (2-Iodo^{131}-3-Nitrobenzoic Acid), Relative Growth Rates of, 395
Oats, Nutritional Disease of, Apparently Due to the Lack of Copper, 398
Obituaries
  Barcroft, Sir Joseph, 160
  Caldwell, Otis William, 576
  Clark, Hubert Lyman, 611
  Huntington, Ellsworth, 632
  Kofoid, Charles Atwood, 462
  Light, S. F., 483
  Woodruff, Lorande Loss, 533
Observatory, Yerkes: Past, Present, and Future, 217
  Some Reminiscences of, 1898–1904, 196
Office of Naval Research, Biological research at Pt. Barrow, 164
  Dental research, 584
Officers
  Alabama Academy of Science, 33
  American Academy of Dental Medicine, 263
    Association of Colleges of Pharmacy, 487
    Chemical Society, Organic Division, 540; Puerto Rico Unit, 443
    Institute of Chemical Engineers, 540
      Electrical Engineers, 33
      Nutrition, 33
    Pharmaceutical Association, 413
    Society for Pharmacology and Experimental Therapeutics, 33
  Association Canadienne-Française pour l'Avancement des Sciences, 443
  Biological Photographic Association, 487
  Botanical Society of America, Pacific Section, 143
  Camp Detrick Sigma Xi Club, 615
  Chicago Academy of Sciences, 9
  Crystallographic Society, 34
  Czechoslovak Academy of Agriculture, 60
  Engineering Foundation, 517
  Florida Academy of Sciences, 583
  Indiana Academy of Science, 635
  Institute of Navigation, 143

- International Association of Milk and Food Sanitarians, Inc., 540
  - Biometric Society, 413
  - Cancer Research Commission, 583
- Kansas Academy of Science, 8
- Korean Society for Scientific Agriculture, 10
- Louisiana Academy of Sciences, 33
- Medical Library Association, 34
- Minnesota Academy of Science, 61
- Mt. Desert Island Biological Laboratory, 263
- New York Academy of Medicine, Section on Microbiology, 11
- Pittsburgh Geological Society, 33
- Poultry Science Association, 339
- Sigma Xi, State College of Washington Chapter, 487
  - University of Oregon Chapter, 61
- Society for American Archaeology, 33
  - Cell Biology, 540
- Society of American Bacteriologists, Ohio Branch, 517
- Tau Beta Pi, 413
- Texas Archaeological and Paleontological Society, 517
- United Engineering Trustees, Inc., 517
- Virginia Academy of Science, 34
- West Virginia Academy of Science, 34
- Western Society for Clinical Research, 583

- "Oil Shales," Natural Formation of Petroleum-like Hydrocarbons From, 41
- Oklahoma Baptist University, Expansion of Geology Department, 538; graduate assistantships, 615
- Olive Oil as a Solvent for Certain Organic Vapors, 274
- Onion Vapors, The Chemical Components of, Responsible for Wound-healing Qualities, 625
- Operational Analysis in Relation to Administration of Government-sponsored Research, 113
- Orla-Jensen, *Microbacterium lacticum*, Vitamin Requirements of, 524
- Osmium Tetroxide, Oxidation of β-Carotene With, 375
- Ovarian Grafts, Intrapancreatic, Granulosa Cell Tumors in, in Castrated Mice, 270
- Oxidase, Cytochrome, 471
- Oxidation of Ascorbic Acid to Dehydroascorbic Acid, 451
  - Of β-Carotene With Osmium Tetroxide, 375
  - -Reduction Indicators, Activation of Eggs by, 320
- Oxidative Metabolism of *Trypanosoma lewisi*, Effect of Age of Infection Upon, 168
- Oxygen and Air Pressure Effects Upon the Early Development of the Frog's Egg, 295
- Oyster, Fecundity of, 290
  - Gonad, Volume of Eggs in, 342
  - Larvae, Staining of, as a Method for Studies of Their Movements and Distribution, 597

P

- Pain, Effect of, on Urine Excretion, 265
- Papaya (*Carica papaya* L.), Transmission of the Bunchy Top Disease of, by the Leaf Hopper *Empoasca papayae* Oman, 130
- Paraffin, Importance of Controlling Cooling Temperatures During Embedding in, 475
- Passage of Certain Viruses, Simple Technic for, 549
- Passports, Difficulties in Obtaining, 341
  - Comment on, 616
- Pathogens, Fungi That Cause Decay of Heartwood Are, 62
- Peat, Microfossils in, Use of Trisodium Phosphate With Herbarium Material and, 325
- Pen, Simple, for Kymograph Tracings, 451
- Penicillin Aerosols of High Concentration, 316
  - Amorphous, Ortho-Hydroxyphenylacetic Acid From, 373
  - And Streptomycin, 616
    - Sensitivity to, Method for Determining, 171
  - As an Agent for Sterilization of Protozoan Cultures, 327
  - Blood Levels, Enhancement of, Following Oral Administration of Caronamide, 494
  - Dust, Inhalation of, 249
  - Glutathione and, 146
  - Salts, Insoluble, Use of, for the Prolongation of Penicillin Blood Levels, 370
  - Types Produced by *P. chrysogenum* Q-176, 192
- Penicillins, Biosynthesis of, 503
- *P. chrysogenum* Q-176, Penicillin Types Produced by, 192
- *Penicillium notatum*, Induction of Mutants in, by Methyl-bis(β-chloroethyl)-amine, 35
- Pepsin, Trypsin and, Inactivation of Staphylocoagulase by, 347
- Peptides, Isomeric, in Kidney Homogenate Digests, Ammonia Nitrogen Produced From, 369
- Perception, Visual, in Man and Chimpanzee, Development of, 107
- *Peridroma margaritosa* (Haw.), the Variegated Cutworm, New Disease of, 323
- Pertussal Antigens, Soluble, Separation and Immunologic Evaluation of, 36
- Petri Dishes and Pipettes, Bacteriological, Improved and Improvised Sterilizing Containers for, 170
- Petroleum—Today and Tomorrow, 603
- Petroleum-like Hydrocarbons, Natural Formation of, From "Oil Shales," 41
- pH Measurements, Concentric Glass Electrode Assembly for, 597
- Phagocytosis, Intercellular Surface, 86
- Pharmacological Study, Use of the Hydra for, 328
- Phenol Formaldehyde and Vinyl Resins, Use of, in Sealing Liquid Mounting Media on Microscope Slides, 299
- Phenyl Arsenoxides, Substituted, Filaricidal Activity of, 105
- Phosphate, Trisodium, in Microscopical Technic, Use of, 194
- Phosphorus, Inorganic, Vitamin D and the Utilization of: The Effects of Vitamins on Phosphorus Metabolism in the Chick Embryo, 637
- Photoelectric Colorimeter, Adaptation of the Silicomolybdic Acid Method for the Estimation of Morphine to, 298
- Photographic Society of America, Traveling Print Shows, 541
- Photometer, Flame, Improving the Performance of, 551
- "Physics, Social," Suggested Principles of, 179
- Physiological Availability of Iodine in Dithymol Diiodide, 317
- Phytotoxicity, Differential, of Metabolic By-Products of *Helminthosporium victoriae*, 270
- Pituitaries, Dried Anterior, of *Rana pipiens*, Seasonal Variation in the Gonadotropic Potency of, 588
- Pituitary Protein, Crystalline, With High Growth Activity, 402
- Planck's Constant C_2, Freezing Points of Cobalt and Nickel and a New Determination of, 428
- Plankton (Micro-) Organisms, Marine, Lethal Effect of X-Rays on, 245
- Plant Cell Lineages, Irreversible Differentiation in Certain, 320
  - Breeding Operations, Flower Marker for, 645
  - Collecting, Formaldehyde in, 250
  - Growth Regulator (2-Iodo^{131}-3-Nitrobenzoic Acid), Labeled, Relative Growth Rates of Bean and Oat Plants Containing Known Amounts of, 395

- Growth Regulators, Reaction of Certain, With Ion Exchangers, 268
- Plants, Herbaceous, Direct Introduction of Chemical Substances Into, 251
  - Sub-tropical, Growth Hormone Determination in, 316
- Plasma Accelerator Factor and Purified Prothrombin Activation, 41
  - L-Methionine Levels Following Intravenous Administration in Humans, 319
  - Rate of Disappearance From, of Intravenously Administered Methionine in Patients With Liver Damage, 589
- *Plasmodium vivax*, Preservation of, by Freezing, 300
- Plasticizing Kymograph Records, Solution for, 350
- Plotting ED_{50} Curves, Instrument for, 151
- Poland in the World of Science, 308
- Polar Regions, Some Problems of Human Ecology in, 405
- Poliomyelitis Virus, Formaldehyde-inactivated, Preparation of, and Its Use as an Immunizing Agent in Cotton Rats, 104
- Polydactyly and Limb Duplication Occurring Naturally in the Tiger Salamander, *Ambystoma tigrinum*, 641
- Polysulfides in Levinstein Process Mustard Gas, 355
- Polytechnic Institute of Brooklyn, Ph.D. in Applied Mechanics, 287
- Polytetrafluoroethylene for the Prevention of "Bumping" From Superheating of Boiling Fluids, 646
- Polyvinyl Alcohol, Use of, to Preserve Fecal Smears for Subsequent Staining, 42
- Potency Estimation, Direct, Bioassay by, 89
  - Percentage, in Three- and Four-Dose Assay Procedures, Simple Formulas for Calculating, 152
- Poultry Meat, Effect of Benzene Hexachloride on the Flavor of, 422
- Precipitation, Sulfur Collection in, by Means of an All-Weather Noncorrosive Rain and Snow Gauge, 19
- Pregnant Women, Recording Uterine Contraction Patterns in: Application of the Strain Gage in a Multichannel Tokodynamometer, 427
- Premedical Education, Conference on, 125
- Prenatal Injury, Dental Aspects of, 415
- Pressure, Low Barometric, Humidity and Tolerance to, 67
- Protactinium Samples, Routine Analysis of the Alpha Activity of, 400
- Protein, Crystalline Pituitary, With High Growth Activity, 402
  - Fat, and Glucose, Homogeneous Emulsion of, for Intravenous Administration, 474
  - Native, 73
- Proteins, Analytical Determination of Basic Groups in Amino Acids and, 277
- Prothrombin Activation, Purified, Plasma Accelerator Factor and, 41
- Prothrombokinase and the Three Stages of Blood Coagulation, 546
- Protozoan Cultures, Penicillin as an Agent for Sterilization of, 427
- *Pseudomonas aeruginosa*, *Escherichia coli*, and *Bacillus subtilis*, Variants of, Requiring Streptomycin, 587
- Psychology as Science, 84
  - Military, in War and Peace, 155
- Pteroylglutamic Conjugates, Action of, on Man, 619
- Public, Science and, 23
- Publishing, Scientific, in Continental Europe: Notes on Its War and Postwar Status, 54
  - Technical Book, in Europe, 1947: Impressions From Visits to Eleven Countries, 47
- Pyridoxal or Pyridoxamine in the Nutrition of Certain Bacteria, Relationship Between Cystine and, 420
- Pyrophosphate, Tetraethyl, Effect of, on Sympathetic Ganglionic Activity, 492

R

- Radcliffe College, Fellowships, 615
- Radiation-induced Lethals in *Drosophila*, Note on the Theory of, 87
- Radioactive Iodine, Use of, as a Tracer in the Study of the Physiology of Teeth, 132
  - I^{131}, Interlaboratory Comparison of Measurements of, 302
- Radioactive Testosterone, 248
- Radioactivity, Natural, of Living Matter, Cosmic Radiocarbon and, 88
- Radiocarbon, Cosmic, and Natural Radioactivity of Living Matter, 88
- Radiochemistry Laboratories, Monitoring Probe for, 327
- Rainbows, Unusual, of July 20, 1947, 225
- *Ramalina reticulata* Lichen, Antibiotic Compound Isolated From, 394
- *Rana pipiens*, Seasonal Variation in the Gonadotropic Potency of Dried Anterior Pituitaries of, 588
- Rat, Effect of Tetraethylammonium Chloride in Experimental Gastric Ulceration in, 448
- Rats, Oral Efficacy of BAL in Protecting, Against Alloxan Diabetes, 343
- Rectal Culture Tube, New, 275
- Red Blood Cell Sensitivity to the Blood-Group-Enzyme, 296
- Reed College, Course on the Development of the Experimental Sciences, 240
- Reference File, Simple Method for Cross-indexing, 109
- Reflex Centers, Vagal Inspiratory and Expiratory, Separate Localization in the Medulla Oblongata of, 322
- Rensselaer Polytechnic Institute, Advanced degrees in education, 338
  - Nuclear chemistry laboratory, 581
- Reproductive Cycles of Five Species of Texas Centrarchids, 85
- Research Centers, Educational Programs at, 283
- Research, Government-sponsored, Operational Analysis in Relation to Administration of, 113
- Resins, Synthetic, Mounting of Dermatological Material With, 646
- Resources, World Soil and Fertilizer, 83
- Reviews
  - Books reviewed by author:
    - Abbot, C. G., The earth and the stars, 228
    - Alexander, Franz, French, Thomas Morton, *et al.*, Psychoanalytic therapy, 600
    - Anson, M. L., and Edsall, John T. (Eds.), Advances in protein chemistry (Vol. 3), 71
    - Baldwin, Ernest, Dynamic aspects of biochemistry, 554
    - Brand, Louis, Vector and tensor analysis, 623
    - Callaham, Ludmilla Ignatiev, Russian-English technical and chemical dictionary, 22
    - Carswell, T. S., High polymers, Vol. VII: Phenoplasts: their structure, properties, and chemical technology, 528
    - Chester, K. Starr, The nature and prevention of the cereal rusts as exemplified in the leaf rust of wheat. (*Annales Cryptogamici et Phytopathologici*, Vol. IV, Frans Verdoorn, Ed.), 112
    - Clemens, Wilbert A., and van Wilby, G., Fishes of the Pacific Coast of Canada, 553
    - Cotton, C. A., Geomorphology (4th ed.), 174
    - Culver, Charles A., Musical acoustics (2nd ed.), 22
    - Dann, W. J., and Satterfield, G. Howard (Eds.), Estimation of the vitamins (Biological Symposia, Vol. XII), 600

Dawes, Ben, The Trematoda of British fishes, 112
Degering, Ed. F., and collaborators, The work book of fundamental organic chemistry, 528
Delmonte, John, The technology of adhesives, 354
Deming, Horace G., Fundamental chemistry: an elementary textbook for college classes (2nd ed.), 278
Drinker, C. K., Folch, J., Cobb, S., Gasser, H. S., Penfield, W., and Strecker, E. A., Psychiatric research, 377
Dyson, G. Malcolm, A new notation and enumeration system for organic compounds, 377
Eastman, E. D., and Rollefson, G. K., Physical chemistry, 601
Eddington, A. S., Fundamental theory, 226
Edwards, Linden F., Concise anatomy, 502
Emerson, Fred W., Basic botany, 601
Fernelius, W. Conard (Ed.-in-Chief), Inorganic syntheses (Vol. II), 252
Fishbein, Morris, A history of the American Medical Association, 1847–1947, 478
Flint, Richard Foster, Glacial geology and the Pleistocene epoch, 278
Frenkel, J., Kinetic theory of liquids, 174
Friedmann, Herbert, The birds of North and Middle America (Pt. X), 46
Glasstone, Samuel, Thermodynamics for chemists, 303
Grollman, Arthur, Essentials of endocrinology (2nd ed.), 454
Hicks, J. S., Low-pressure laminating of plastics, 502
Hinshelwood, C. N., The chemical kinetics of the bacterial cell, 354
Hogben, Lancelot, An introduction to mathematical genetics, 45
Holm, Ragnar, Electric contacts, 602
Imperatori, Charles J., and Burman, Herman J., Diseases of the nose and throat (3rd ed.), 304
Jeffreys, Harold, and Bertha Swirles, Methods of mathematical physics, 227
Johnson, Martin, Time, knowledge, and the nebulae: an introduction to the meanings of time in physics, astronomy, and philosophy, and the relativities of Einstein and of Milne, 227
Kamen, Martin D., Radioactive tracers in biology: an introduction to tracer methodology, 329
Kinsey, Alfred C., Pomeroy, Wardell B., and Martin, Clyde E., Sexual behavior in the human male, 622
Lauer, Henri, Lesnick, Robert, and Matson, Leslie E., Servomechanism fundamentals, 602
Lipson, C., and Murray, W. M. (Eds.), Proceedings of the Society for Experimental Stress Analysis (Vol. IV, No. 2), 624
McIntyre, A. R., Curare: its history, nature, and clinical use, 430
Mather, K., Statistical analysis in biology (2nd ed.), 154
Maynard, Leonard A., Animal nutrition (2nd ed.), 92
Merchant, Ival Arthur, Veterinary bacteriology (3rd ed.), 92
Messer, Harold M., An introduction to vertebrate anatomy (Rev. ed.), 528
Michotte, A., La perception de la causalité, 600
Montagu, M. F. Ashley, Adolescent sterility: a study in the comparative physiology of the infecundity of the adolescent organism in mammals and man, 430
Murnaghan, Francis D., Differential and integral calculus: functions of one variable, 623
Parke, Nathan Grier, III, Guide to the literature of mathematics and physics including related works in engineering science, 553
Peatman, John Gray, Descriptive and sampling statistics, 329
Peters, John P., and Van Slyke, Donald D., Quantitative clinical chemistry: interpretations (Vol. I; 2nd ed.), 454
Potter, Ralph K., Kopp, George A., and Green, Harriet C., Visible speech, 278
Reddick, H. W., and Miller, F. H., Advanced mathematics for engineers (2nd ed.), 502
Rufus, W. Carl, and Tien, Hsing-Chih, The Soochow astronomical chart, 227
Schwab, G. M. (Ed.), Handbuch der Katalyse. Vol. 3: Biokatalyse, 252
Selye, Hans, Encyclopedia of endocrinology. Section IV: The ovary; Vol. VII: Ovarian tumors, 21
Shapiro, Harry H., Applied anatomy of the head and neck: for students and practitioners of dentistry (2nd ed.), 134
Smith, Edward S., Salkover, Meyer, and Justice, Howard K., Unified calculus, 354
Spies, Tom D., Rehabilitation through better nutrition, 92; Experiences with folic acid, 92
Strausbaugh, Perry D., and Weimer, Bernal R., General biology (2nd ed.), 252
Strong, Reuben Myron, A bibliography of birds: with special reference to anatomy, behavior, biochemistry, embryology, pathology, physiology, genetics, ecology, aviculture, economic ornithology, poultry culture, evolution and related subjects, 71
Thomas, Islyn, Injection molding of plastics, 430
Thompson, Allyn J., Making your own telescope, 228
Thompson, Henry Dewey, Fundamentals of earth science, 454
Wald, Abraham, Sequential analysis, 303
Watson, W. H., The physical principles of wave guide transmission and antenna systems, 601
Weber, Robert L., White, Marsh W., and Manning, Kenneth V., College technical physics, 303
Welcher, Frank J., Organic analytical reagents (Vol. I), 72
Willmer, E. N., Retinal structure and colour vision: a restatement and an hypothesis, 154
Wiselogle, Frederick Y. (Ed.), A survey of antimalarial drugs, 1941–1945, 134
Wolff, Werner, What is psychology?, 553
Yost, Don M., Russell, Horace, Jr., and Garner, Clifford S., The rare-earth elements and their compounds, 112

Books reviewed by title:
Adolescent sterility: a study in the comparative physiology of the infecundity of the adolescent organism in mammals and man, M. F. Ashley Montagu, 430
Advanced mathematics for engineers (2nd ed.), H. W. Reddick and F. H. Miller, 502
Advances in protein chemistry (Vol. 3), M. L. Anson and John T. Edsall (Eds.), 71
Animal nutrition (2nd ed.), Leonard A. Maynard, 92
Applied anatomy of the head and neck: for students and practitioners of

dentistry (2nd ed.), Harry H. Shapiro, 134
Basic botany, Fred W. Emerson, 601
Bibliography of birds: with special reference to anatomy, behavior, biochemistry, embryology, pathology, physiology, genetics, ecology, aviculture, economic ornithology, poultry culture, evolution and related subjects, Reuben Myron Strong, 71
Birds of North and Middle America (Pt. X), Herbert Friedmann, 46
Chemical kinetics of the bacterial cell, C. N. Hinshelwood, 354
College technical physics, Robert L. Weber, Marsh W. White, and Kenneth V. Manning, 303
Concise anatomy, Linden F. Edwards. 502
Curare: its history, nature, and clinical use, A. R. McIntyre, 430
Descriptive and sampling statistics, John Gray Peatman, 329
Differential and integral calculus: functions of one variable, Francis D. Murnaghan, 623
Diseases of the nose and throat (3rd ed.), Charles J. Imperatori and Herman J. Burman, 304
Dynamic aspects of biochemistry, Ernest Baldwin, 554
Earth and the stars, C. G. Abbot, 228
Electric contacts, Ragnar Holm, 602
Encyclopedia of endocrinology. Section IV: The ovary; Vol. VII: Ovarian tumors, Hans Selye, 21
Essentials of endocrinology (2nd ed.), Arthur Grollman, 454
Estimation of the vitamins (Biological Symposia, Vol. XII), W. J. Dann and G. Howard Satterfield (Eds.), 600
Experiences with folic acid, Tom D. Spies, 92
Fishes of the Pacific Coast of Canada, Wilbert A. Clemens and G. van Wilby, 553
Fundamental chemistry: an elementary textbook for college classes (2nd ed.), Horace G. Deming, 278
Fundamental theory, A. S. Eddington, 226
Fundamentals of earth science, Henry Dewey Thompson, 454
General biology (2nd ed.), Perry D. Strausbaugh and Bernal R. Weimer, 252
Geomorphology (4th ed.), C. A. Cotton, 174
Glacial geology and the Pleistocene epoch, Richard Foster Flint, 278
Guide to the literature of mathematics and physics including related works in engineering science, Nathan Grier Parke, III, 553
Handbuch der Katalyse. Vol. 3: Biokatalyse, G. M. Schwab (Ed.), 252
High polymers, Vol. VII: Phenoplasts: their structure, properties, and chemical technology, T. S. Carswell, 528
History of the American Medical Association, 1847–1947, Morris Fishbein, 478
Injection molding of plastics, Islyn Thomas, 430
Inorganic syntheses (Vol. II), W. Conard Fernelius (Ed.-in-Chief), 252
Introduction to mathematical genetics, Lancelot Hogben, 45
Introduction to vertebrate anatomy (Rev. ed.), Harold M. Messer, 528
Kinetic theory of liquids, J. Frenkel, 174
Low-pressure laminating of plastics, J. S. Hicks, 502
Making your own telescope, Allyn J. Thompson, 228
Methods of mathematical physics, Harold and Bertha Swirles Jeffreys, 227
Musical acoustics (2nd ed.), Charles A. Culver, 22
Nature and prevention of the cereal rusts as exemplified in the leaf rust of wheat. (*Annales Cryptogamici et Phytopathologici*, Vol. IV. Frans Verdoorn, Ed.), K. Starr Chester, 112
New notation and enumeration system for organic compounds, G. Malcolm Dyson, 377
Organic analytical reagents (Vol. I), Frank J. Welcher, 72
Perception de la causalité, A. Michotte, 600
Physical chemistry, E. D. Eastman and G. K. Rollefson, 601
Physical principles of wave guide transmission and antenna systems, W. H. Watson, 601
Proceedings of the Society for Experimental Stress Analysis (Vol. IV, No. 2), C. Lipson and W. M. Murray (Eds.), 624
Psychiatric research, C. K. Drinker, J. Folch, S. Cobb, H. S. Gasser, W. Penfield, and E. A. Strecker, 377
Psychoanalytic therapy, Franz Alexander, Thomas Morton French, *et al.*, 600
Quantitative clinical chemistry: interpretations (Vol. I; 2nd ed.), John P. Peters and Donald D. Van Slyke, 454
Radioactive tracers in biology: an introduction to tracer methodology, Martin D. Kamen, 329
Rare-earth elements and their compounds, Don M. Yost, Horace Russell, Jr., and Clifford S. Garner, 112
Rehabilitation through better nutrition, Tom D. Spies, 92
Retinal structure and colour vision: a restatement and an hypothesis, E. N. Willmer, 154
Russian-English technical and chemical dictionary, Ludmilla Ignatiev Callaham, 22
Sequential analysis, Abraham Wald, 303
Servomechanism fundamentals, Henri Lauer, Robert Lesnick, and Leslie E. Matson, 602
Sexual behavior in the human male, Alfred C. Kinsey, Wardell B. Pomeroy, and Clyde E. Martin, 622
Soochow astronomical chart, W. Carl Rufus and Hsing-Chih Tien, 227
Statistical analysis in biology (2nd ed.), K. Mather, 154
Survey of antimalarial drugs, 1941–1945, Frederick Y. Wiselogle (Ed.), 134
Technology of adhesives, John Delmonte, 354
Thermodynamics for chemists, Samuel Glasstone, 303
Time, knowledge, and the nebulae: an introduction to the meanings of time in physics, astronomy, and philosophy, and the relativities of Einstein and of Milne, Martin Johnson, 227
Trematoda of British fishes, Ben Dawes, 112
Unified calculus, Edward S. Smith, Meyer Salkover, and Howard K. Justice, 354
Vector and tensor analysis, Louis Brand, 623
Veterinary bacteriology (3rd ed.), Ival Arthur Merchant, 92
Visible speech, Ralph K. Potter, George A. Kopp, and Harriet C. Green, 278
What is psychology?, Werner Wolff, 553
Work book of fundamental organic chemistry (Rev. ed.), Ed. F. Degering and collaborators, 528
Rickettsial and Viral Infections, Chloromycetin, an Antibiotic With Chemo-

  therapeutic Activity in Experimental, 418
Rockefeller Institute for Medical Research, Consolidation of activities, 186
Royal Society, London, Newton project, 102
Russian Literature, Committee on (Geological Society of America), 518
Rutin, Effect of, on Anaphylactic and Histamine Shock, 368, 469

S

Salamander, Tiger, *Ambystoma tigrinum*, Polydactyly and Limb Duplication Occurring Naturally in, 641
Saliva, Citric Acid in, 343
  Of Children Drinking Artificially Fluorinated and Fluorine-free Communal Waters, *Lactobacillus acidophilus* Counts in, 292
Salt, Disappearance of, From Glass Ice During Low-Temperature Dehydration, and Its Implication in Electron Microscopy, 543
Sandstone, Red and Yellow, Nature of the Iron Compounds in, 470
Schizophrenia, Is It Inherited?, 12
Science and public policy, Report of President's Scientific Research Board, 339
Science and Technology, Mission on, London, 518
  And the Public, 23
  Poland in the World of, 308
    Psychology as, 84
  Talent Search, Seventh Annual, 514
Sciences, Survey of, 135
  Biological and Medical, UNESCO Initiates Cooperation in the Abstracting of, 609
Scientific Book Register, 46, 72, 134, 174, 228, 304, 330, 378, 478, 554, 624
Scientific Education, Languages and, 490
  Papers, Editing of, 289, 491
  Publishing in Continental Europe: Notes on Its War and Postwar Status, 54
Scientists, Younger, Shift of Employment Among, 3
Sea Water Systems at Marine Laboratories, 171
Sedimentation in the Gulf of Mexico, Recent Changes in, 460
Seeds, Relative Sensitivity of Dormant and Germinating, to 2,4-D, 266
Seedstalk Development in Celery, Chemical Control of, 590
Sensitivity to Penicillin and Streptomycin, Method for Determining, 171
Sera, Human, Elimination of the False Positive Reaction With, in Complement Fixation Tests, 43
Serum, Human, Adenosinetriphosphatase Activity of, 167
  Lipids, Inactivation of Certain Neurotropic Viruses *in Vitro* by, 267
  Of Patients With Acquired Hemolytic Anemia, New Antibody in, 293
Sex, The Nucleus in Relation to Heredity and, 305
Sickle Cells, Linkage Between the Genes for, and the M-N Blood Types, 347
Silicomolybdic Acid Method for the Estimation of Morphine, Adaptation of, to the Photoelectric Colorimeter, 298
Simpson, James Y., 100th anniversary of use of chloroform, 488
Slide Rule for Determining Chicken Red Cell Agglutination Titer, 273
Sludged Blood, 431
"Social Physics," Suggested Principles of, 179
Soil Actinomycete, Chloromycetin, a New Antibiotic From, 417
  Survey Work, Reconnaissance, in Japan, 256
Soils, Submerged, Solubility of Iron in 595
Solar Research and Theoretical Astrophysics, 213
Solid Objects, Small, Method for Determining the Volume of, 425
South African Council for Scientific and Industrial Research, Liaison offices, 61
Soybean, Role of Inhibitors in, 421
Spectroscopic Laboratory, 215
Spectroscopy, Stellar, 204
Spectrum, Ultraviolet Absorption, of Cerebrospinal Fluid: Ascorbic Versus Nucleic Acid, 64
Sphygmograph, Improved Electromagnetic, 376
Spleen Extract and Tumor Growth, 348
  Monocytes in, Origin of, 346
Spontaneous Activity of Small Animals, Kinesimeter for Studying, 499
Sporotrichum, Common Antigenic Factor in Different Species of, 146
Staining of Nerve Endings in Mouse Epidermis by Feulgen's Nucleal Reaction, 70
  Subsequent, Use of Polyvinyl Alcohol to Preserve Fecal Smears for, 42
Staphylocoagulase, Inactivation of, by Trypsin and Pepsin, 347
Starch-like Material From Glucose-1-phosphate by Diphtheria Bacilli, Production of, 523
Starring in *American Men of Science*, 359
  Comment on, 617
Staticin Caronamide, 264
Stellar Spectroscopy, 204
  System, Studies of, 201
Stereotaxic Apparatus for Operations on the Human Brain, 349
Sterility, Male, in the Carrot, 594
Sterilizing Containers, Improved and Improvised, for Bacteriological Petri Dishes and Pipettes, 170
Stevens Institute of Technology, Fluid dynamics program, 59
Streptomycin and Penicillin, Method for Determining Sensitivity to, 171
  In Vitro Resistance of the Genus *Bacteroides* to, 423
  Penicillin and, 616
  Remote Sustained Threshold Therapeutic Action of, in Tuberculosis, 446
  -Resistant Variants in the Human Strain of Tubercle Bacillus H-37RV, Demonstration of Naturally-occurring, 476
  Therapy in Experimental Tuberculosis of Guinea Pigs Infected Intracerebrally With Virulent Tubercle Bacilli, 638
  Subtilin and, Antibiotic Activity of, in the Presence of BAL, 643
  Variants of *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus subtilis* Requiring, 587
Subtilin and Streptomycin, Antibiotic Activity of, in the Presence of BAL, 643
Sulfonamides, Color Reactions of, With β-Naphthoquinone-4-Sulfonate, 426
Sulfur Collection in Precipitation by Means of an All-Weather Noncorrosive Rain and Snow Gauge, 19
Sun Oil Company, Proposed Science Center, 538
Swedish Deep Sea Expedition, 366
Switch, Interval-Timing, Automatically Resetting, to Operate After Any Given Number of Counts, 324
Sympathetic Ganglionic Activity, Effect of Tetraethyl Pyrophosphate on, 492
Sympathin E, Chemical Structure and the Definition of, 520
Synaptic Transmission Against Block by Nicotine, Protection of, 421

T

Tadpoles of *Bufo cognatus* and *Bufo compactilis*, 166
Technical Book Publishing in Europe, 1947: Impressions From Visits to Eleven Countries, 47
Teeth, Use of Radioactive Iodine as a Tracer in the Study of the Physiology of, 132
Termites, Higher, Development of Castes in, 244
  Methods for Culturing, 131

Testosterone, Radioactive, 248
Tetraethyl Pyrophosphate, Effect of, on Sympathetic Ganglionic Activity, 492
Tetraethylammonium Chloride, Effect of, in Experimental Gastric Ulceration in the Rat, 448
Tetroxide, Osmium, Oxidation of β-Carotene With, 375
Thallium, Abundance of, in the Earth's **Crust, 268**
Therapeutic Action of Streptomycin in Tuberculosis, Remote Sustained Threshold, 446
Thermodynamics of Deformation, 445
Three-dimensional Graphs, 326
Tidal Illumination Diagrams, 76
Tissue Cells and Mitotic Index, Wright's Hypothesis: Its Relation to Volume Growth of, 343
  Culture, Mincing Apparatus for the Preparation of Embryo Extract for, 621
  Normal and Tumor, of Human Origin, Ultraspectrophotometric Studies in Extracts of, 346
Tissues, Normal and Malignant, Fluorescein as an Agent in the Differentiation of, 130
  Vital, Triphenyltetrazolium Chloride as a Dye for, 294
Tokodynamometer, Multichannel, Application of the Strain Gage in: Recording Uterine Contraction Patterns in Pregnant Women, 427
Tracer Micrography, 69
Training of Engineers, Importance of Ecology in, 1
Trephine, Use of an Electric Drill-operated, in Preparing Turtles for Heart Beat Studies, 622
Trimmer, Precision Micro-Pipette, 598
Triphenyltetrazolium Chloride as a Dye for Vital Tissues, 294
Trisodium Phosphate in Microscopical Technic, Use of, 194
  Use of, With Herbarium Material and Microfossils in Peat, 325
Trypanosoma cruzi (KR), Action of the Endotoxin of, on Malignant Mouse Tumors, 591
Trypanosoma lewisi, Effect of Age of Infection Upon the Oxidative Metabolism of, 168
Trypsin and Pepsin, Inactivation of Staphylocoagulase by, 347
Tubercle Bacillus H-37RV, Demonstration of Naturally-occurring Streptomycin-resistant Variants in the Human Strain of, 476
Tuberculosis, Experimental, of Guinea Pigs Infected Intracerebrally With Virulent Tubercle Bacilli, Streptomycin Therapy in, 638
  Streptomycin in, Remote Sustained Threshold Therapeutic Action of, 446
Tumor Growth, Spleen Extract and, 348
  Lymph Node, and Normal Tissues of Surgical Patients, Comparison of the β-Glucuronidase Activity of, 66
  Lymphoid, in Chickens, Contagious Nature of, 246
  Tissue of Human Origin, Ultraspectrophotometric Studies in Extracts of Normal and, 346
Tumors, Granulosa Cell, in Intrapancreatic Ovarian Grafts in Castrated Mice, 270
  Malignant Mouse, Action of the Endotoxin of *Trypanosoma cruzi* (KR) on, 591
Turtles, Loggerhead, Migration of Newly-hatched, Toward the Sea, 398
  Preparing, for Heart Beat Studies, Use of an Electric Drill-operated Trephine in, 622

U

Ulceration, Experimental Gastric, in the Rat, Effect of Tetraethylammonium Chloride in, 448
Ultraspectrophotometric Studies in Extracts of Normal and Tumor Tissue of Human Origin, 346
Ultraviolet Absorption Spectrum of Cerebrospinal Fluid: Ascorbic Versus Nucleic Acid, 64
  Light, Some Effects of, on 2,4-D and Related Compounds, 37
Undercooling, Water, Interesting Case of, 453
UNESCO Initiates Cooperation in the Abstracting of Biological and Medical Sciences, 609
U. S. National Museum, Reorganization of Department of Biology, 224
U. S. Public Health Service, Advisory Board on Nomenclature of Anti-Rh Typing Serums, 288
  Courses in the Laboratory Diagnosis of Parasitic Diseases, 489
Units, Simple Method for Changing, 352
University of California, Expedition to Sterkfontein, 286
    Santa Barbara College, New Departments of Biological and Physical Sciences, 287
  Chicago, Cancer Research Foundation, 515
    Department of Astronomy, 195
    Program in nuclear physics, 81
  Cincinnati, Institute of Industrial Health, 184; Asteroid center, 222
  Delaware, Course on Application of Statistical Methods to Design of Experiments and Analysis of Data, 581
  Illinois, Chicago Professional Colleges, Department of Clinical Science, 615.
  Michigan, Human Heredity Studies, 287
  Notre Dame, Engineering flight demonstration program, 163
  Pennsylvania, Program of Indian and related Asian studies, 514
  Rochester, Spastic paralysis program, 337
  Southern California, New Department of Biochemistry and Nutrition, 538
  Toledo, Program in glass technology, 81
  Washington, New Department of Meteorology and Climatology, 515
  Wisconsin, History of Science courses, 412
Uremia, Intestinal Perfusion in the Treatment of, 108
Ureteral Catheter for Microinjection Tubing, 551
Urine Flow in Rats, Relation of Inulin Clearance to Rate of, 127, 341
  Effect of Pain on, 265
Use-Dilution Concentrations of Quaternary Ammonium Germicides, Rapid Method for Estimation of, 525
Uterine Contraction Patterns in Pregnant Women, Recording: Application of the Strain Gage in a Multichannel Tokodynamometer, 427

V

Vaccines, Simplified Techniques for Inoculating Chick Embryos and a Means of Avoiding Egg White in, 324
Vagal Inspiratory and Expiratory Reflex Centers, Separate Localization in the Medulla Oblongata of, 322
Vapors, Certain Organic, Olive Oil as a Solvent for, 274
Vinyl Resins, Use of Phenol Formaldehyde and, in Sealing Liquid Mounting Media on Microscope Slides, 299
Viruses, Certain Neurotropic, Inactivation of, *in Vitro* by Serum Lipids, 267
  Passage of Certain, Simple Technic for, 549
Visual Perception in Man and Chimpanzee, Development of, 107
Vitamin A, Utilization of, in Water Emulsion, 40
  D and the Utilization of Inorganic Phosphorus: The Effects of Vitamins on Phosphorus Metabolism in the Chick Embryo, 637
  Nomenclature, 226
  Requirements of *Microbacterium lacticum* Orla-Jensen, 524

Volume of Small Solid Objects, Method for Determining, 425

W

Warburg Vessel, Modified, 550
Water Undercooling, Interesting Case of, 453
Weeds, Woody, in Cuba, Use of 2,4-D Weed Killers on, 87
Weight Physiology of the Mouse, Elementary Effect of Arginase in, 393
Whittlesey House and *Science Illustrated*, Scientific book contest, 465
Witch Hazel, Initiation of the Cone Gall of, 419
Worcester Foundation for Experimental Biology, 312
Wound-healing Qualities, The Chemical Components of Onion Vapors Responsible for, 625
Wright's Hypothesis: Its Relation to Volume Growth of Tissue Cells and Mitotic Index, 343

X

X-Rays, Lethal Effect of, on Marine Microplankton Organisms, 245

Y

Yale University, Course on the Development of the Sciences, 32
Yeast Autolysate: A Culture Medium for *Hemophilus influensae*, 350
  Culture, Continuous, Apparatus for, 43
Yerkes Observatory: Past, Present, and Future, 217
  Some Reminiscences of, 1898–1904, 196

Z

Zoological Nomenclature, International Commission on, Applications for suspension of *Règles Internationales*, 487, 584
  Cowdria ruminantium, 62
  Errors and Emendations of, 315
  Occupancy, Availability, and Validity, 11
  Paramecium multimicronucleatum versus *Paramecium nucleatum*, 491

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